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National Aeronautics and
Space Administration

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California Institute of Technology
Pasadena, California 91103

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16. Abstract

JPL Bibliography 39-18 describes and indexes the formalized technical reporting, released January through December 1975, that resulted from scientific and engineering work performed, or managed, by the Jet Propulsion Laboratory. Five classes of publications are included:

(1) Technical Reports

(2) Technical Memorandums

(3) Articles from bi-monthly Deep Space Network (DSN) Progress Report

(4) Special Publications

(5) Articles published in the open literature

The publications are indexed by: (1) author, (2) subject, and (3) publication type and number. A descriptive entry appears under the name of each author of each publication; an abstract is included with the entry for the primary (first-listed) author. Unless designated otherwise, all publications listed are unclassified.

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Publications of the Jet Propulsion Laboratory 1976

July 15, 1977

National Aeronautics and
Space Administration

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California 91103

Prepared Under Contract No. NAS 7-100
National Aeronautics and Space Administration

Foreword

JPL Bibliography 39-18 describes and indexes the formalized technical reporting, released during calendar year 1976, that resulted from scientific and engineering work performed, or managed, by the Jet Propulsion Laboratory. Five classes of publications are included:

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(3) Articles from the bimonthly *Deep Space Network (DSN) Progress Report* (42-series). Each collection of articles in this new class of publication beginning with 42-20 presents a periodical survey of current accomplishments by the Deep Space Network. Formerly, each collection of articles was published as a separate volume of Technical Report 32-1526.

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(5) Articles published in the open literature.

The publications are indexed by: (1) author, (2) subject, and (3) publication type and number. A descriptive entry appears under the name of each author of each publication; an abstract is included with the entry for the primary (first-listed) author.

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Contents

Author Index With Abstracts

leigh scattering, was used to make an apparent pressure map of Hellas. Anomalously high pressures are interpreted as clouds developing over the southern part of Hellas near the time of autumnal equinox. The blue ratio (reflectance at 2680 Å divided by reflectance at 3050 Å) showed a 20% increase from Revolution 40 to Revolution 74 (December 4, 1971, to December 20, 1971), attributed to the decay of the dust storm. Thereafter, the blue ratio remained essentially constant through Revolution 214, which implies that the rate of clearing in Hellas was much slower than that planetwide.

A08 Complex Refractive Index of Martian Dust: Mariner 9 Ultraviolet Observations

K. D. Pang, J. M. Ajello, C. W. Hord (University of Colorado), and W. G. Egan (Grumman Aerospace Corporation)

Icarus, Vol. 27, No. 1, pp. 55–67, January 1976

For abstract, see Pang, K. D.

A09 Mariner 9 Ultraviolet Spectrometer Experiment: Bright-Limb Observations of the Lower Atmosphere of Mars

J. M. Ajello, K. D. Pang, A. L. Lane, C. W. Hord (University of Colorado), and K. E. Simmons (University of Colorado)

J. Atmos. Sci., Vol. 33, No. 3, pp. 544–552, March 1976

Analysis of the bright-limb profiles obtained by the Mariner 9 ultraviolet spectrometer during the December 1971 dust storm on Mars shows that the dust extended to an altitude of 70 ± 10 km, with a sharp cutoff in altitude distribution. Above the dust layer, the reflected signal is characterized by Rayleigh scattering in the wavelength interval 2100 to 3500 Å. Detached haze layers were detected at an altitude of 70 ± 10 km at the top of the dust layer. The haze layers have a nominal optical thickness of $10^{-4\pm1}$ and a geometrical thickness of 3 to 10 km and are probably a condensate of small CO_2 or H_2O ice particles (mean radius <0.1 μm). Similar features were revealed in Mariner 9 TV pictures of the limb.

A10 A Photoionization Mass Spectrometer Study of $CFCl_3$, CF_2Cl_2, and CF_3Cl

J. M. Ajello, W. T. Huntress, Jr., and P. Rayermann

J. Chem. Phys., Vol. 64, Vol. 11, pp. 4746–4754, June 1, 1976

A photoionization mass spectrometer has been used over the wavelength range 650–1100 Å (19.07–11.27 eV) to determine the appearance potentials, heats of formation, and photoionization efficiencies of the following ions: $CFCl_2^+$, CCl_3^+, $CFCl^+$, and CCl_2^+ from $CFCl_3$; $CF_2Cl_2^+$, $CFCl_2^+$, CF_2Cl^+, $CFCl^+$, and CF_2^+ from CF_2Cl_2; and CF_3Cl^+, CF_3^+, and CF_2^+ from CF_3Cl. The parent ion $CFCl_3^+$ of $CFCl_3$ was not observed.

AKLONIS, J. J.

A11 A Generalization of the Boltzmann Superposition Principle to Polymer Networks Undergoing Scission

J. Moacanin, J. J. Aklonis, and R. F. Landel

J. Chem. Phys., Vol. 64, No. 1, p. 430, January 1, 1976

For abstract, see Moacanin, J.

A12 Viscoelastic Behavior of Elastomers Undergoing Scission Reactions

J. Moacanin, J. J. Aklonis, and R. F. Landel

J. Macromol. Sci.—Phys., Vol. B11, No. 1, pp. 41–55, 1975

For abstract, see Moacanin, J.

ALBERDA, M. E.

A13 DSN Telemetry System Performance With Convolutionally Coded Data Using Operational Maximum-Likelihood Convolutional Decoders

B. Benjauthrit, B. D. L. Mulhall, B. D. Madsen, and M. E. Alberda

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 81–101, December 15, 1976

For abstract, see Benjauthrit, B.

ALSBERG, H.

A14 A System for the Direct Digitization of Electron Images From a TEM

R. E. Hartman, H. Alsberg, R. S. Hartman, R. Nathan, and P. Wendell

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. I, pp. 96–97

For abstract, see Hartman, R. E.

A15 The Improved Stability of an Organic Crystal in the Hitachi HV-1 High Vacuum Electron Microscope

R. S. Hartman, R. E. Hartman, H. Alsberg, and R. Nathan

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. II, pp. 674–675

For abstract, see Hartman, R. S.

AMOROSE, R. J.

A16 Viking Mission Support

R. J. Amorose and D. W. Johnston

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 11–19, October 15, 1976

This report summarizes Deep Space Network support for the two Viking Missions to Mars and includes the Mars orbit insertions of Vikings 1 and 2 and the landing of Viking 1. Special procedures were employed during these critical events to minimize interruptions to the telemetry data return due to spacecraft data mode and attitude changes.

ANANDA, M.

A17 Mean Rates of the Orbital Elements of a Satellite Perturbed by a Lens Shaped Mass Concentration

M. Ananda

Celest. Mech., Vol. 12, No. 4, pp. 495–511, December 1975

Long arc gravity analysis of lunar orbiter tracking data in the past has been carried out with the help of averaged equations of motion, in which short period effects have been suppressed. This procedure has required that the harmonic terms in the gravity potential be averaged over an orbital period. In this paper, we extend this technique to mass points and mass discs in the gravity field. This required the evaluation of expressions for the mean rates of the orbit elements for a satellite perturbed by a lens shaped mass concentration. Corresponding expressions for the perturbations due to a mass point are obtained in the limit as the lens radius goes to zero. The derived equations have been programmed on the UNIVAC 1108 computer, and the results checked by numerical differencing.

A18 Farside Lunar Gravity From a Mass Point Model

M. Ananda

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 2785–2796, 1975

A mass point representation of the lunar gravity field was determined from the long-periodic orbital variations of the Apollo 15 and 16 subsatellites and Lunar Orbiter V. A radial acceleration contour map, evaluated at 100-km altitude from the lunar surface, shows that the nearside is in close agreement with the result derived from the line-of-site method by Muller and Sjogren. The farside map shows the highland regions as broad positive gravity anomaly areas and the basins such as Korolev, Hertzsprung, Moscoviense, Mendeleev, and Tsiolkovsky as localized, negative gravity anomaly regions. The farside map has a first-order agreement with the result derived from the harmonic field method by Ferrari. The mass points analysis indicates that the nearside is almost all negative gravity anomaly regions except for the known positive mass anomaly basins (mascons), and the farside is almost all positive gravity anomaly regions except for some localized negative areas near the basins.

ANDERSON, J. D.

A19 Experimental Test of General Relativity Using Time-Delay Data From Mariner 6 and Mariner 7

J. D. Anderson, P. B. Esposito, W. L. Martin, C. L. Thornton, and D. O. Muhleman (California Institute of Technology)

Astrophys. J., Vol. 200, No. 1, pp. 221–233, August 15, 1975

Range and Doppler data from Mariner 6 and Mariner 7 have been analyzed for purposes of measuring the effect of the Sun's gravity field on S-band radio transmissions to the spacecraft The prediction of general relativity, that the round-trip time delays between the station and the spacecraft will be increased by about 200 μ near superior conjunction, has been verified with an uncertainty of 3 percent or less. The value for the parameter $\gamma^* = (1 + \gamma)/2$, which multiplies the Einstein prediction of the "excess" delay in the ranging signal, is $\gamma^* = 1.00 \pm 0.03$, where the uncertainty represents a realistic standard deviation. The dominant error source on the experiment is the stochastic nongravitational forces which act on the spacecraft and which limit the accuracy of the determination of the Mariner orbits. Effects of free coronal electrons on the round-trip propagation also make the measurement difficult, but the coronal contribution to the error in γ^* is only about 1 percent. Separate analyses of data from Mariner 6 and Mariner 7 yield two values near unity for γ^* which differ by about 0.3 percent from each other. This and other considerations suggest that the error in the experiment is perhaps less than 3 percent.

A20 Gravity Fields

W. L. Sjogren, J. D. Anderson, R. J. Phillips, and D. W. Trask

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 172–183, July 1976

For abstract, see Sjogren, W. L.

ANDERSON, T. O.

A21 **DSN Standard Interface Adapter and Buffer Assembly Used in the Mark III Data System**

T. O. Anderson

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 75–83, August 15, 1976

This article describes the DSN Standard Interface Adapter and Buffer Assembly (referred to as the "900/SIA") used to effect interface compatibility between the Xerox Data Systems 920 computer (XDS 920) and the Mark III Data System (MDS) processors. It sets forth the requirements based on the differences between the two systems. Described are the operational characteristics and general design strategy as well as certain efficient implementation techniques used. From a software standpoint, the transfer protocol is discussed to a level of detail sufficient for its operation.

ANICICH, V. G.

A22 **Laboratory Studies of Ion-Neutral Reactions in Interstellar Regions: Gas-Phase Equilibrium Between HCN and NH_3 in Dense Clouds**

W. T. Huntress, Jr. and V. G. Anicich

Astrophys. J., Vol. 208, No. 1, pp. 237–244, August 15, 1976

For abstract, see Huntress, W. T., Jr.

A23 **Ion Cyclotron Resonance Studies of Some Reactions of C^+ Ions**

V. G. Anicich W. T. Huntress, Jr., and J. H. Futrell (University of Utah)

Chem. Phys. Lett., Vol. 40, No. 2, pp. 233–236, June 1, 1976

Product distributions and rate constants for the reaction of ground state C^+ ions with O_2, NO, HCl, CO_2, H_2O, HCN, NH_3, CH_4, H_2CO, CH_3OH, and CH_3NH_2 have been measured. Rate constants were obtained using ion cyclotron resonance trapped ion methods at JPL, and product distributions were obtained using a tandem (Dempster-ICR) mass spectrometer at the University of Utah. Rapid carbon isotope exchange has also been observed in C^+–CO collisions.

A24 **On the Reaction of N^+ Ions with O_2**

W. T. Huntress, Jr. and V. G. Anicich

Geophys. Res. Lett., Vol. 3, No. 6, pp. 317–318, June 1976

For abstract, see Huntress, W. T., Jr.

A25 **Comments on "Reactions of Excited and Ground State H_3^+ Ions With Simple Hydrides and Hydrocarbons"**

V. G. Anicich (University of Utah), J. H. Futrell (University of Utah), W. T. Huntress, Jr., and J. K. Kim

Int. J. Mass Spectrom. Ion Phys., Vol. 18, No. 1, pp. 63–64, September 1975

This short communication presents follow-on comments to an earlier report regarding ICR data on reactions of vibrationally excited H_3^+ ions and observations of charge transfer from vibrationally excited H_3^+ ions to C_2H_2.

ANTCLIFFE, G. A.

A26 **A Large Imaging Array CCD Program**

F. E. Vescelus and G. A. Antcliffe (Texas Instruments Inc.)

Proc. SPIE Conf. Low Light Level Devices for Sci. and Technol., Reston, Va., Mar. 22–23, 1976, Vol. 78, pp. 60–64

For abstract, see Vescelus, F. E.

ARAZI, B.

A27 **A New Class of Burst-Correcting Cyclic Codes**

B. Arazi

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 188–200, April 15, 1976

In many DSN communication systems (the GCF, computer-computer data transfer, etc.), transmission errors tend to occur in intermittent bursts. In this article a new class of burst-error-correcting codes, potentially applicable to DSN systems, is described. Many of these codes are superior to any previously known.

ARENS, W. E.

A28 **The Application of Charge-Coupled Device Technology to Produce Imagery from Synthetic Aperture Radar Data**

W. E. Arens

Preprint 76-967, AIAA Conf. Syst. Design Driven by Sensors, Pasadena, Calif., Oct. 18–20, 1976

A real-time aircraft synthetic aperture radar (SAR) image processor using charge-coupled device (CCD) technology has been developed. Both range and azimuth convolution are accomplished using CCD transversal filtering in the

analog domain. The computational equivalency of a CCD transversal filter to comparatively more complex digital processing implementations provides significant reductions in processor power, weight, size, and cost requirements. This paper describes the results of the aircraft CCD SAR image-processor development work to date. Furthermore, it extrapolates these results to provide visibility into the CCD SAR signal-processing potential for future spacecraft applications.

ARNOLD, J. R.

A29 Chemical Mapping of Planetary Surfaces

E. L. Haines, J. R. Arnold (University of California, San Diego), and A. E. Metzger

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 141–153, July 1976

For abstract, see Haines, E. L.

A30 Preliminary Design and Performance of an Advanced Gamma-Ray Spectrometer for Future Orbiter Missions

A. E. Metzger, R. H. Parker, J. R. Arnold (University of California, San Diego), R. C. Reedy (Los Alamos Scientific Laboratory), and J. I. Trombka (Goddard Space Flight Center)

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 2769–2784, 1975

For abstract, see Metzger, A. E.

ARP, H.

A31 The Problem of Spiral Galaxies and Satellite Radio Sources

H. Arp (Hale Observatories), R. Carpenter, S. Gulkis, and M. Klein

Astrophys. J., Vol. 205, No. 3, pp. 721–727, May 1, 1976

Regions 2° × 2° in area centered on four spiral galaxies (Shapley-Ames catalog) were scanned with the Goldstone 64-m antenna in search of satellite radio sources at 2295 MHz. Four control regions of equal area but free of galaxies brighter than 13th magnitude were also scanned. No significant excess in the number density of sources with flux densities greater than 0.10 Jy relative to the control fields was found. A detailed comparison is made between the results of this program and the results of previous investigators. In particular, we call attention to the potentially important implications of an investigation by Tovmasyan, who searched a large number of spirals and found evidence that a small percentage of them apparently have radio satellites located up to 20′ from the central galaxy. We measured 15 sources selected from Tovmasyan's list of 43 satellite sources. Our results confirm his positions and relative flux densities for each of the sources.

ASSEFI, T.

A32 Some Existence and Sufficient Conditions of Optimality

T. Assefi

Technical Memorandum 33-764, February 15, 1976

Some existence and sufficient conditions of current interest in the field of optimal-control theory are discussed. This report briefly describes the role of existence and sufficiency conditions in the field of optimal control. The existence theorems are discussed for general nonlinear systems. However, the sufficient conditions pertain to "nearly" linear systems with integral convex costs. Moreover, a brief discussion of linear systems with multiple-cost functions is presented.

A33 Shuttle Experiment Pointing Mount (EPM) Systems

E. Mettler, E. L. Marsh, R. S. Ward, and T. Assefi

Preprint 76-964, AIAA Conf. Syst. Design Driven by Sensors, Pasadena, Calif., Oct. 18–20, 1976

For abstract, see Mettler, E.

AUMANN, H. H.

A34 Infrared Multidetector Spectrometer for Remote Sensing of Temperature Profiles in the Presence of Clouds

H. H. Aumann and M. T. Chahine

Appl. Opt., Vol. 15, No. 9, pp. 2091–2094, September 1976

An infrared multidetector spectrometer with channels in the 4.3- and 15-μm CO_2 bands for the remote sensing of temperature profiles in the presence of clouds is described. Results obtained from aircraft flights in July 1975 over ocean sites under various conditions of cloudiness demonstrate the capability of the dual frequency technique to recover surface temperatures to an accuracy of ±0.5 K in the presence of up to 90% cloud cover.

BACK, L. H.

B01 An Experimental Investigation of Fluid Flow and Heating in Various Resonance Tube Modes

V. Sarohia, L. H. Back, E. J. Roschke, and S. P. Parthasarathy

Technical Memorandum 33-780, September 1, 1976

For abstract, see Sarohia, V.

B02 Blast Wave in a Nozzle for Propulsive Applications

G. Varsi, L. H. Back, and K. Kim

Acta Astronautica, Vol. 3, Nos. 1/2, pp. 141–156, January/February 1976

For abstract, see Varsi, G.

B03 Measurement of Detonation Propulsion in Helium and Performance Calculations

K. Kim, L. H. Back, and G. Varsi

AIAA J., Vol. 14, No. 3, pp. 310–312, March 1976

For abstract, see Kim, K.

B04 Shock Wave/Turbulent Boundary-Layer Interactions With and Without Surface Cooling

L. H. Back and R. F. Cuffel

AIAA J., Vol. 14, No. 4, pp. 526–532, April 1976

An experimental investigation was conducted to delineate the structure of the flowfield and temperature distributions in a shock wave/turbulent boundary-layer interaction with and without surface cooling. The Mach number upstream was about 3.5, and the wave angle was 23 deg. The wall to stagnation temperature ratio was 0.44 with cooling and 1.1 with heating. A detailed map of the interaction flowfields deduced from numerous boundary-layer traversing stations revealed the influence of wall cooling on the flowfield, wave structure, and size of the flow separation region. With surface cooling, the size of the separation region was much smaller, and the separation and reflected shock waves merged together near the edge of the velocity boundary layer, extending into the freestream as one wave. The measured rise in pressure p_1/p_2 across the interactions of 3.1-3.2 could be estimated using oblique shock relations in conjunction with the observation that the mass flux $\rho V \propto 1/r$ in the expanding flow between the incident and separation shock waves in the diffuser. The increase in the measured heat-transfer coefficient $h_2/h_1 = 2.3$ and wall shear stress $\tau_2/\tau_1 = 1.6$-1.7 across the interactions were estimated reasonably well by using semiempirical relations.

B05 Compressible Laminar Boundary Layers with Large Acceleration and Cooling

L. H. Back and R. F. Cuffel

AIAA J., Vol. 14, No. 7, pp. 968–971, July 1976

An approximate prediction method involving the integral form of the momentum equation is extended to deduce the flow quantities of interest when compressibility effects become important and heat transfer may occur.

B06 Optical and Physical Requirements for Fluid Particles Marking Trailing Vortices from Aircraft

L. H. Back

J. Aircraft, Vol. 13, No. 7, pp. 483–489, July 1976

A theoretical study of the optical and physical requirements of marking trailing vortices that emanate from aircraft wings was carried out by considering particulate light-scattering properties, ability of particles to follow trailing vortices, and survival time of particles to vortex dissipation. Liquid droplets undergoing evaporation and molecular dispersion were investigated. Droplets should have lifetimes of about 300 s. Droplet size should be about 1 μ to maximize light scattering with the minimum mass of liquid required. Droplets of this small size would spiral outward very slowly and essentially remain in the vortex cores. Nontoxic hygroscopic liquids, having an affinity for moisture in the air, have been identified. These liquids have relatively low vapor pressures or order 10^{-5} mm Hg that would insure droplet persistence long enough to mark trailing vortices.

B07 The Influence of Upstream Conditions on Flow Reattachment Lengths Downstream of an Abrupt Circular Channel Expansion

E. J. Roschke and L. H. Back

J. Biomech., Vol. 9, No. 7, pp. 481–483, 1976

For abstract, see Roschke, E. J.

BALL, G. G.

B08 Requirements and Capabilities for Planetary Missions: Mars Polar Orbiter/Penetrator 1981

G. G. Ball and T. H. Bird

Special Publication 43-27, Vol. 2, March 1976

This volume presents one of a series of requirements and capabilities for planetary missions assembled from recent study activities at JPL. The purpose of this series of documents is to provide a summary of these studies which may be readily used in subsequent efforts. Emphasis is upon requirements and associated capabilities of the spacecraft and mission design as developed in the study. No particular priority of individual missions should be assumed from the sequence of these reports.

B09 **Requirements and Capabilities for Planetary Missions: Venus Orbiter Imaging Radar 1983**

D. H. Kindt, G. G. Ball, and T. H. Bird

Special Publication 43-27, Vol. 3, August 1976

For abstract, see Kindt, D. H.

BANNISTER, R. W.

B10 **LUMIS, Land Use Management and Information Systems: Coordinate Oriented Program Documentation**

N. A. Bryant, C. K. Paul, A. J. Landini, R. W. Bannister, and T. Logan

Special Publication 43-33, November 1, 1976

For abstract, see Bryant, N. A.

BAR-DAVID, I.

B11 **Design Criteria for Noncoherent Gaussian Channels With MFSK Signaling and Coding**

S. A. Butman, I. Bar-David (Israel Institute of Technology), B. K. Levitt, R. F. Lyon (Stanford Telecommunications, Inc.), and M. J. Klass (University of California, Berkeley)

IEEE Trans. Commun., Vol. COM-24, No. 10, pp. 1078–1088, October 1976

For abstract, see Butman, S. A.

BARENGOLTZ, J. B.

B12 **Correlation of Displacement Effects Produced by Electrons, Protons, and Neutrons in Silicon**

V. A. J. van Lint, G. Gigas, and J. B. Barengoltz

IEEE Trans. Nucl. Sci., Vol. NS-22, No. 6, pp. 2663–2668, December 1975

For abstract, see van Lint, V. A. J.

BATELAAN, P. D.

B13 **Development of a Water Vapor Radiometer to Correct for Tropospheric Range Delay in DSN Applications**

P. D. Batelaan, T. Sato, S. D. Slobin, and H. F. Reilly, Jr.

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 77–84, June 15, 1976

The rationale for a Water Vapor Radiometer (WVR) as an aid in predicting tropospheric delay correction is presented. Included is a block diagram and a description of the present developmental WVR with the semiautomated operating sequence outlined. A brief summary of field tests at El Monte airport and Pt. Mugu is given.

B14 **A Demonstration of a Transportable Radio Interferometric Surveying System With 3-cm Accuracy on a 307-m Base Line**

K. M. Ong, P. F. MacDoran, J. B. Thomas, H. F. Fliegel, L. J. Skjerve, D. J. Spitzmesser, P. D. Batelaan, S. R. Paine, and M. G. Newsted (Trend Western Engineering Corporation)

J. Geophys. Res., Vol. 81, No. 20, pp. 3587–3593, July 10, 1976

For abstract, see Ong, K. M.

BATES, E. T.

B15 **Time-Dependent MOS Breakdown**

S. P. Li, E. T. Bates, and J. Maserjian

Solid-State Electron., Vol. 19, No. 3, pp. 235–239, March 1976

For abstract, see Li, S. P.

BAUMERT, L. D.

B16 **Decoding with Multipliers**

L. D. Baumert, R. J. McEliece, and G. Solomon

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 43–46, August 15, 1976

A general technique, called decoding with multipliers, is presented that can be used to decode any linear code. The technique is applied to the (48,24) quadratic residue code and yields the first known practical decoding algorithm for this powerful code.

BEATTY, R. W.

B17 **S- X-Band Experiment: Development and Evaluation of a Set of Group Delay Standards**

T. Y. Otoshi and R. W. Beatty

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 50–64, April 15, 1976

For abstract, see Otoshi, T. Y.

BECHTOL, C.

B18 Graphite Fiber-Reinforced-Bone Cement

A. C. Knoell H. Maxwell, and C. Bechtol (Join Implant Surgery and Research Foundation, Los Angeles)

Ann. Biomed. Eng., Vol. 3, No. 2, pp. 225–229, June 1975

For abstract, see Knoell, A. C.

BECKENBACH, E. S.

B19 Digital Image Processing of Vascular Angiograms

R. H. Selzer, D. H. Blankenhorn (University of Southern California), E. S. Beckenbach, D. W. Crawford (University of Southern California), and S. H. Brooks (University of Southern California)

Proc. SPIE Conf. Cardiovascular Imaging and Image Processing, Theory and Practice, Stanford, Calif., July 1975, Vol. 72, pp. 159–162

For abstract, see Selzer, R. H.

BEER, R.

B20 Paraxial Ray Analysis of a Cat's-Eye Retroreflector: Comments

R. Beer

Appl. Opt., Vol. 15, No. 4, p. 856, April 1976

The author comments on two articles on the paraxial ray analysis of cat's-eye retroreflectors, criticizing certain aspects of the methods described.

B21 Jupiter and the Boron Problem

R. Beer

Icarus, Vol. 29, No. 2, pp. 193–199, October 2, 1976

The "cosmic" abundance of boron is one of the least well known of all the 92 natural elements even though it can appear in substantial concentrations on the Earth's surface. It is suggested that Jupiter might be a suitable place to search for boron because it forms numerous stable, volatile compounds with hydrogen and other abundant elements whose presence might be sought either spectroscopically or by entry devices.

B22 New Apodizing Functions for Fourier Spectrometry

R. H. Norton and R. Beer

J. Opt. Soc. Amer., Vol. 66, No. 3, pp. 259–264, March 1976

For abstract, see Norton, R. H.

BEJCZY, A. K.

B23 Distribution of Control Decisions in Remote Manipulation

A. K. Bejczy

Proc. 1975 IEEE Conf. Decision and Control, Houston, Tex., Dec. 10–12, 1975, pp. 81–91

The particular characteristics of the problem of distributing control decisions between man and computer in remotely controlled manipulation are discussed. State of the art is reviewed from two viewpoints: (1) Specifications of both control commands and control context of sensor signals the operator inputs to the manipulator control computer. (2) Operations the manipulator control computer performs on operator commands and real-time sensor signals to control the manipulator for a specified task. JPL breadboard systems, system components, and control experiments are described related to the development and evaluation of manipulator control systems with capabilities of distributing control decisions between man and computer.

BENJAUTHRIT, B.

B24 Final Report on DSN Telemetry System Performance With Convolutionally Coded Data: Maximum Likelihood Decoding

B. Benjauthrit

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 112–122, June 15, 1976

This report finalizes the analysis of DSN telemetry system performance based on the convolutionally coded data for the short constraint length 7:1/2 codes at low-bit rates, 8 to 2048 bits per second, obtained from CTA 21 for the block III type, S-band configuration. The results indicate that a loss of one or more decibels in the system performance may be expected due to system degradation. Also, burst error lengths up to 100 bits may not be unusual in actual operational situations.

B25 **DSN Telemetry System Performance With Convolutionally Coded Data Using Operational Maximum-Likelihood Convolutional Decoders**

B. Benjauthrit, B. D. L. Mulhall, B. D. Madsen, and M. E. Alberda

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 81–101, December 15, 1976

This article describes the DSN telemetry system performance with convolutionally coded data using the operational maximum-likelihood convolutional decoder being implemented in the Network. The report covers data rates from 80 bps to 115.2 kbps and both S- and X-band receivers. The results of both one- and two-way radio losses are included.

BENTON, W. D.

B26 **Recent Developments at JPL in the Application of Digital Image Processing Techniques to Astronomical Images**

J. J. Lorre, D. J. Lynn, and W. D. Benton

Proc. SPIE Conf. Image Processing, Pacific Grove, Calif., Feb. 24–26, 1976, Vol. 74, pp. 234–238

For abstract, see Lorre, J. J.

BERGMAN, L. A.

B27 **Bit Error Rate Measurement for Evaluation of a Fiber Optic Link**

L. A. Bergman and A. R. Johnston

Proc. SPIE Conf. Fibers & Integrated Opt., Reston, Va., Mar. 22–23, 1976, Vol. 77, pp. 78–86

Digital fiber optic data link terminal modules are being developed in a number of laboratories, and often the modules take the form of black boxes without convenient access to internal signals. This paper discusses types of measurements which can be made using only the digital terminals of the link. Bit-error-rate (BER) vs signal power data can, of course, provide a means for providing overall link performance, but it can also be used to determine certain internal parameters of the receiver. The theoretical dependence of the BER vs light signal power curve shape on receiver input noise equivalent power and comparator slicing level is discussed. BER vs light signal power measurements obtained with an experimental link are presented and interpreted with the aid of the theoretical curves. The effect of other problems, such as hum or oscillation on the BER data, is mentioned. Sensitivity of the system BER to bit rate is also discussed, with application to determining system operating limits. Since BER measurements are simple to make and can easily be automated, they may prove to be a useful means for either laboratory evaluation or production-line acceptance testing of sealed terminal modules.

BERGSTRALH, J. T.

B28 **Uranian Methane Abundance Rotational Temperature, and Effective Pressure From the 6800 Å Band**

J. T. Bergstralh

Astrophys. J., Vol. 202, No. 3, pp. 832–838, December 15, 1975

Measurements of the methane absorption features at 6800 Å in two spectrograms of Uranus have been analyzed on the working hypothesis that the features are the R branch of the $5\nu_3$ rotation-vibration overtone. Internal and external consistencies in temperature calculations from the measurements give increased confidence that the band identification and rotational quantum number assignments to band members are correct. Parametric fitting of synthetic reflecting layer (RLM) and homogeneous scattering layer (HSL) spectra to the spectrograms was attempted. The best fit of an HSL spectrum was obtained with a temperature of 100 K and methane abundance in the range $2 \lesssim \eta N \lesssim 8$ km-amagat. Best results for an HSL spectrum were $T = 100$ K and $0.5 \lesssim Nl \lesssim 2$ km-amagat. These methane abundances, taken with recent estimates of the molecular hydrogen abundance, correspond to an average C:H ratio between 1.5 and 25 times larger than the solar ratio. Even greater enrichment of the C:H ratio may occur below the visible cloud boundary. High spectroscopic resolution of the present data permits direct measurement of the methane line halfwidth in Uranus's spectrum. The halfwidth corresponds to an effective pressure greater than 3 atm, depending on the mixture of atmospheric gases. Pressure in this range, at the methane rotational temperature $93 \lesssim T \lesssim 100$ K, is inconsistent with current Uranus atmosphere models having solar elemental abundance ratios It is consistent with models which are considerably enriched in "heavier" constituents.

B29 **Photometry of 433 Eros From 0.65 to 2.2 μm**

G. J. Veeder, D. L. Matson, J. T. Bergstralh, and T. V. Johnson

Icarus, Vol. 28, No. 1, pp. 79–85, May 1976

For abstract, see Veeder, G. J.

BERKMAN, R. M.

B30 **Consideration of Probability of Bacterial Growth for Jovian Planets and Their Satellites**

D. M. Taylor, R. M. Berkman, and N. Divine

Life Sciences and Space Research XIII, pp. 111–118, Akademie-Verlag, Berlin, 1975

For abstract, see Taylor, D. M.

BERMAN, A. L.

B31 The Prediction of Zenith Range Refraction From Surface Measurements of Meteorological Parameters

A. L. Berman

Technical Report 32-1602, July 15, 1976

This report presents the prediction of zenith range refraction from surface measurements of meteorological parameters. Refractivity is separated into wet (water vapor pressure) and dry (atmospheric pressure) components. The integration of dry refractivity is shown to be exact. Attempts to integrate wet refractivity directly prove ineffective; however, several empirical models developed by the author and other researchers at JPL are discussed. The best current wet refraction model is here considered to be a separate day/night model ("Berman (D/N)"), which is proportional to surface water vapor pressure and inversely proportional to surface temperature. The standard deviation of this model is considered to be: $\sigma \approx 1.5 - 2.0$ cm. Methods are suggested that might improve the accuracy of the wet range refraction model; however, the information content in surface parameters is considered insufficient to allow a surface measurements model for wet range refraction to result in a standard deviation lower than $\sigma \approx 1.0 - 1.5$ cm.

B32 Analysis of Solar Effects Upon Observed Doppler Noise During the Helios 1 Second Solar Conjunction

A. L. Berman

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 262–276, April 15, 1976

This report analyzes observed doppler noise during the Helios 1 second solar conjunction with the previously presented $NOISE_p$ solar noise model. It is concluded that the $NOISE_p$ model continues to adequately predict "average" solar corruption of observed doppler noise, and that deviations from the $NOISE_p$ model continue to appear to correlate in some fashion with fluctuations in observed solar activity.

B33 Doppler Noise Considered as a Function of the Signal Path Integration of Electron Density

A. L. Berman and J. A. Wackley

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 159–193, June 15, 1976

This article advances the hypothesis that observed doppler noise during solar conjunctions is proportional to total columnar electron content along the signal path. This assumption leads directly to a geometrical model (ISED) for observed doppler noise which is shown to be in very good agreement with doppler noise data accumulated during the 1975 Pioneer 10, Pioneer 11, and Helios 1 solar conjunctions. An augmented model (RISED) is constructed which quantitatively indicates correlation between Earth-observed sunspot activity and systematic, cyclical deviations from the ISED model. Applications expected from this effort are: (1) ability to validate generation of doppler data during solar conjunctions, (2) ability to predict solar corruption of doppler data during mission critical phases which occur during solar conjunctions, and (3) possibility of extracting electron density information from observed doppler noise.

B34 The Pioneer 11 1976 Solar Conjunction: A Unique Opportunity to Explore the Heliographic Latitudinal Variations of the Solar Corona

A. L. Berman, J. A. Wackley, S. T. Rockwell, and J. G. Yee

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 136–147, October 15, 1976

The 1976 Pioneer 11 Solar Conjunction provided the opportunity to accumulate a substantial quantity of doppler noise data over a dynamic range of signal closest approach point heliographic latitudes. The observed doppler noise data were fit to the (previously developed) doppler noise model "ISED", and the deviations of the observed doppler noise data from the model were used to construct a (multiplicative) function to describe the effect of heliographic latitude (ϕ_s):

$$f(\phi_s) = 10^{-0.9(\phi_s/90\ \text{deg})}$$

This expression was then incorporated (back) into the ISED model to produce a new doppler noise model—"ISEDB."

B35 Viking 1 Planetary Phase Tracking Operations: Mars Orbit Insertion Through Landing

A. L. Berman and J. A. Wackley

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 148–170, October 15, 1976

This article describes tracking operations during the Viking 1 planetary phase. Particular attention is paid to special planning for critical phase tracking operations,

and to the degree of success subsequently achieved by these special plans during the actual operations. In-depth coverage is provided for Mars orbit insertion, periapsis passage tracking, and Lander direct links. The article concludes that, on balance, tracking operations during the Viking 1 planetary phase (to date) have been effectively implemented and quite successful.

B36 Differential Range Validation: A New Technique for Near-Real-Time Validation of Multistation Ranging System Data

A. L. Berman

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 114–120, December 15, 1976

Near-real-time validation of ranging system data is currently restricted to multiple range aquisitions during single passes (Pseudo-DRVID). This article describes a new technique ("Differential Range Validation") which utilizes predicted range and doppler pseudo-residuals to validate two-station, contiguous-pass range acquisitions down to the 10-meter level.

B37 The 1976 Helios and Pioneer Solar Conjunctions—Continuing Corroboration of the Link Between Doppler Noise and Integrated Signal Path Electron Density

A. L. Berman, J. A. Wackley, and S. T. Rockwell

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 121–137, December 15, 1976

Observed doppler noise (rms phase jitter) from the 1976 solar conjunctions of the Helios 1 and 2 and the Pioneer 10 and 11 spacecraft was processed with a recently developed doppler noise model "ISEDB." Good agreement is obtained between the observed data and the model. Correlation is shown between deviations from the ISEDB model and sunspot activity, but it is insufficient to be modeled. Correlation is also shown between ISEDB model deviations for (spacecraft) signal paths on the same side of the sun.

BIERMAN, G. J.

B38 A Numerical Comparison of Discrete Kalman Filtering Algorithms: An Orbit Determination Case Study

C. L. Thornton and G. J. Bierman

Technical Memorandum 33-771, June 15, 1976

For abstract, see Thornton, C. L.

B39 Integration-Free Interval Doubling for Riccati Equation Solutions

G. J. Bierman and G. S. Sidhu (State University of New York)

Technical Memorandum 33-799, October 1, 1976

Starting with certain identities obtained by Reid and Redheffer for general matrix Riccati equations, we give various algorithms for the case of constant coefficients. The algorithms are based on two ideas: (1) relate the RE solution with general initial conditions to anchored RE solutions; and (2) when the coefficients are constant, the anchored solutions have a basic shift-invariance property. These ideas are used to construct an integration-free superlinearly convergent iterative solution to the algebraic RE. Our algorithm, arranged in square-root form, is thought to be numerically stable and competitive with other methods of solving the algebraic RE.

B40 Measurement Updating Using the *U–D* Factorization

G. J. Bierman

Automatica, Vol. 12, No. 4, pp. 375–382, July 1976

The discrete linear filtering problem is treated by factoring the filter error covariance matrix as $P = UDU^T$. Efficient and stable measurement updating recursions are developed for the unit upper triangular factor, U, and the diagonal factor, D. This paper treats only the parameter estimation problem; effects of mapping, inclusion of process noise and other aspects of filtering are treated in separate publications. The algorithm is simple and, except for the fact that square roots are *not* involved, can be likened to square root filtering. Like the square root filter our algorithm guarantees nonnegativity of the computed covariance matrix. As is the case with the Kalman filter, our algorithm is well suited for use in real time. Attributes of our factorization update include: efficient one point at a time processing that requires little more computation than does the optimal but numerically unstable conventional Kalman measurement update algorithm; stability that compares with the square root filter and the variable dimension flexibility that is enjoyed by the square root information filter. These properties are the subject of this paper.

B41 Givens Transformation Techniques for Kalman Filtering

C. L. Thornton and G. J. Bierman

Preprint IAF-76-015, Int. Astronaut. Fed. XXVII Congress, Anaheim, Calif., Oct. 10–16, 1976

For abstract, see Thornton, C. L.

B42 Measurement Updating Using the *U-D* Factorization

G. J. Bierman

Proc. 1975 IEEE Conf. Decision and Control, Houston, Tex., Dec. 10–12, 1975, pp. 337–346

In this paper we describe a fresh approach to the discrete linear filtering problem. Our method involves an upper triangular factorization of the filter error covariance matrix, i.e., $P = UDU^T$. Efficient and stable measurement updating recursions are developed for the unit upper triangular factor, U, and the diagonal factor, D. This paper treats only the parameter estimation problem; effects of mapping, inclusion of process noise, and other aspects of filtering are treated in separate publications. The algorithm is surprisingly simple and, except for the fact that square roots are *not* involved, can be likened to square root filtering. Indeed, like the square root filter our algorithm guarantees nonnegativity of the computed covariance matrix. As in the case of the Kalman filter; our algorithm is well suited for use in real time. Attributes of our factorization update include: efficient one point at a time processing that requires little more computation than does the optimal but numerically unstable conventional Kalman measurement update algorithm; stability that compares with the square root filter and the variable dimension flexibility that is enjoyed by the square root information filter. These properties are the subject of this paper.

B43 Gram-Schmidt Algorithms for Covariance Propagation

C. L. Thornton and G. J. Bierman

Proc. 1975 IEEE Conf. Decision and Control, Houston, Tex., Dec. 10–12, 1975, pp. 489–498

For abstract, see Thornton, C. L.

BILLINGSLEY, F. C.

B44 Landsat Follow-On: A Report by the Applications Survey Groups: Vol. I. Executive Summary

F. C. Billingsley, M. R. Helton, and V. M. O'Brien

Technical Memorandum 33-803, Vol. I, December 15, 1976

In January 1976, NASA requested the Jet Propulsion Laboratory to conduct a study of the attempts at operational usage of the Landsat imagery by non-NASA users. In this study, particular emphasis was to be placed on profitable use of the imagery, as contrasted to those investigations concerned with research and development of a technology. The outcome of the study was to be an evaluation of the proposed Landsat follow-on effort as seen from the point of view of users attempting profitable use. In support of this, four Applications Survey Groups (ASGs) were formed: Mineral and Petroleum Exploration, Inland Water Resources, Land Inventory, and Agriculture. Other possible major interest areas such as Oceanography and Weather and Climate already have operating user groups. It was therefore decided not to try to parallel or duplicate that effort. The members were drawn from all segments of the user community: federal agencies, state and local governments or agencies (or from associations of such constituencies), industry, and universities. They were selected so that in aggregate they would be able to adequately assess the state-of-the-art in their technical areas and represent this in the ASG deliberations. The report is published in two volumes: Volume I presents the executive summary, while Volume II covers discussions of the discipline areas.

B45 Landsat Follow-On: A Report by the Applications Survey Groups: Vol. II. Discipline Discussions

F. C. Billingsley, M. R. Helton, and V. M. O'Brien

Technical Memorandum 33-803, Vol. II, December 15, 1976

In January 1976, NASA requested the Jet Propulsion Laboratory to conduct a study of the attempts at operational usage of the Landsat imagery by non-NASA users. In this study, particular emphasis was to be placed on profitable use of the imagery, as contrasted to those investigations concerned with research and development of a technology. The outcome of the study was to be an evaluation of the proposed Landsat follow-on effort as seen from the point of view of users attempting profitable use. In support of this, four Applications Survey Groups (ASGs) were formed: Mineral and Petroleum Exploration, Inland Water Resources, Land Inventory, and Agriculture. Other possible major interest areas such as Oceanography and Weather and Climate already have operating user groups. It was therefore decided not to try to parallel or duplicate that effort. The members were drawn from all segments of the user community: federal agencies, state and local governments or agencies (or from associations of such constituencies), industry and universities. They were selected so that in aggregate they would be able to adequately assess the state-of-the-art in their technical areas and represent this in the ASG deliberations. The report is published in two volumes: Volume II covers discussions of the discipline areas, while Volume I presents the executive summary.

B46 Digital Image Enhancement Techniques Used in Some ERTS Application Problems

A. F. H. Goetz and F. C. Billingsley

Contrib. Geol., Vol. 12, No. 2, pp. 7–21, 1974

For abstract, see Goetz, A. F. H.

B47 **Discrimination of Rock Types and Detection of Hydrothermally Altered Areas in South-Central Nevada by the Use of Computer-Enhanced ERTS Images**

L. C. Rowan (U.S. Geological Survey), P. H. Wetlaufer (U.S. Geological Survey), A. F. H. Goetz, F. C. Billingsley, and J. H. Stewart (U.S. Geological Survey)

Geological Survey Professional Paper 883, U. S. Government Printing Office, Washington, 1976

For abstract, see Rowan, L. C.

BIRD, T. H.

B48 **Requirements and Capabilities for Planetary Missions: Mars Polar Orbiter/Penetrator 1981**

G. G. Ball and T. H. Bird

Special Publication 43-27, Vol. 2, March 1976

For abstract, see Ball, G. G.

B49 **Requirements and Capabilities for Planetary Missions: Venus Orbiter Imaging Radar 1983**

D. H. Kindt, G. G. Ball, and T. H. Bird

Special Publication 43-27, Vol. 3, August 1976

For abstract, see Kindt, D. H.

BLACKWELL, R. J.

B50 **Document Restoration by Digital Image Processing**

W. H. Spuck, R. J. Blackwell, and J. M. Soha

Amer. Arch., Vol. 39, No. 2, pp. 131–155, April 1976

For abstract, see Spuck, W. H.

BLANKENHORN, D. H.

B51 **Digital Image Processing of Vascular Angiograms**

R. H. Selzer, D. H. Blankenhorn (University of Southern California), E. S. Beckenbach, D. W. Crawford (University of Southern California), and S. H. Brooks (University of Southern California)

Proc. SPIE Conf. Cardiovascular Imaging and Image Processing, Theory and Practice, Stanford, Calif., July 1975, Vol. 72, pp. 159–162

For abstract, see Selzer, R. H.

BORN, G. H.

B52 **The Motions of Phobos and Deimos From Mariner 9 TV Data**

G. H. Born and T. C. Duxbury

Celest. Mech., Vol. 12, No. 1, pp. 77–88, August 1975

Orbit elements for the two Martian satellites Phobos and Deimos have been determined from 80 television photographs of the satellites taken by the imaging system of the Mariner 9 spacecraft. Phobos was found to be within 60 km of its positions predicted by recently published ephemeris theories, which include a secular acceleration term in the longitude. This tends to corroborate the existence of a secular acceleration in the longitude of Phobos. Deimos was found to be within 100 km of its position predicted from Earth-based observations. Comparison of the satellite's orbits determined from Mariner 9 data are made to these same ephemeric theories, which are based on recent processing of Earth-based observations. In addition, the magnitude of periodic perturbations to the satellite orbits due to Mars' gravity field and solar gravity is discussed, and a 110-km-long period perturbation in the longitude of Deimos is identified.

BOUQUET, F. L.

B53 **On the Thermoelastic Analysis of Solar Cell Arrays and Related Material Properties**

M. A. Salama and F. L. Bouquet

Technical Memorandum 33-753, February 15, 1976

For abstract, see Salama, M. A.

BOZINIS, D. G.

B54 **Electron Scattering From Li at 5.4, 10, 20 and 60 eV Impact Energies**

W. Williams S. Trajmar, and D. G. Bozinis (Universidade de Estadual, Campinas, Brazil)

J. Phys. B: At. Mol. Phys., Vol. 9, No. 9, pp. 1529–1536, June 21, 1976

For abstract, see Williams, W.

BRATENAHL, A.

B55 **Energetic Particles of the Outer Regions of Planetary Magnetospheres**

B. T. Tsurutani, B. E. Goldstein, and A. Bratenahl

Technical Memorandum 33-766, March 1, 1976

For abstract, see Tsurutani, B. T.

BRIGHT, L. E.

B56 Tracking Operations During the Helios 2 Launch Phase

L. E. Bright

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 277–295, April 15, 1976

The prelaunch planning for the DSN's participation in the launch of the Helios 2 spacecraft is reviewed from the point of view of the tracking function. The actual events of the initial acquisition are discussed and analyzed in relation to prelaunch plans. In addition, an analysis of the effects of the Helios 2 spacecraft's spin on doppler data is provided.

BROKL, S. S.

B57 512-Channel Correlator Controller

S. S. Brokl

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 34–41, October 15, 1976

JPL and the Haystack Observatory have developed a high-speed correlator for radio and radar observations. To ensure that the host computer could operate during the extended run times of the JPL–Haystack correlator, a controller was designed so that the correlator could run automatically without computer intervention. The correlator controller assumes the role of bus master and keeps track of data and properly interrupts the computer at the end of the observation.

BROOKS, S. H.

B58 Digital Image Processing of Vascular Angiograms

R. H. Selzer, D. H. Blankenhorn (University of Southern California), E. S. Beckenbach, D. W. Crawford (University of Southern California), and S. H. Brooks (University of Southern California)

Proc. SPIE Conf. Cardiovascular Imaging and Image Processing, Theory and Practice, Stanford, Calif., July 1975, Vol. 72, pp. 159–162

For abstract, see Selzer, R. H.

BROWN, R. L.

B59 Observations of Heavy-Element Recombination Lines in the Rho Ophiuchi Dark Cloud at 13 Centimeters Wavelength

G. R. Knapp (California Institute of Technology), T. B. H. Kuiper, and R. L. Brown (National Radio Astronomy Observatory)

Astrophys. J., Vol. 206, No. 1, pp. 109–113, May 15, 1976

For abstract, see Knapp, G. R.

B60 CO Observations of the Expanding Envelope of IRC + 10216

T. B. H. Kuiper, G. R. Knapp (California Institute of Technology), S. L. Knapp (California Institute of Technology), and R. L. Brown (National Radio Astronomy Observatory)

Astrophys. J., Vol. 204, No. 2, pp. 408–414, March 1, 1976

For abstract, see Kuiper, T. B. H.

BROWN, W. E., JR.

B61 Radar Imaging of Ocean Surface Patterns

W. E. Brown, Jr., C. Elachi, and T. W. Thompson

J. Geophys. Res., Vol. 81, No. 15, pp. 2657–2667, May 20, 1976

Radar imagery of ocean surface patterns is presented and discussed. The imaging radar detects changes in ocean surface backscatter and yields imagery of deepwater gravity waves, oil slicks, island shadows, internal waves, coastal waves, and other features. The results of several observations suggest that the surface irregularities behave as isotropic scatterers for a radar wavelength of 25 cm. The popular scattering models are considered in relation to this behavior. The variable incident angle and high resolution of the imaging radar allow one to study the scattering properties of particular surface phenomena.

B62 Lunar Cartography With the Apollo 17 ALSE Radar Imagery

M. F. Tiernan, L. E. Roth, T. W. Thompson, C. Elachi, and W. E. Brown, Jr.

The Moon, Vol. 15, Nos. 1/2, pp. 155–163, January/February 1976

For abstract, see Tiernan, M. F.

BRUBAKER, L.

B63 Modification of Moore Measuring Machine/Leitz Microscope

H. A. Greth and L. Brubaker

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 147–148, June 15, 1976

For abstract, see Greth, H. A.

BRUNN, D. L.

B64 Multipath Tests on 64-m Antennas Using the Viking Orbiter-1 and -2 Spacecraft as Far-Field Illuminators

T. Y. Otoshi and D. L. Brunn

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 41–49, February 15, 1976

For abstract, see Otoshi, T. Y.

BRYAN, A. I.

B65 Compatibility Test System for Use With the Mark III DSN Data Subsystems Implementation

A. I. Bryan and G. H. Winn

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 5–8, February 15, 1976

This article reports on the Compatibility Test System that will be used at the Compatibility Test Area, JPL, Pasadena (CTA 21), and the Spacecraft Compatibility/Monitor Station, Merritt Island, Florida (STDN MIL 71), to perform telecommunications compatibility tests with the Mariner Jupiter–Saturn 1977 and the Pioneer Venus 1978 spacecraft. The functional design of the new system utilizes capabilities provided by a Compatibility Test Assembly and the Mark III DSN Data Subsystems configuration. A discussion of the Compatibility Test System implementation identifies the special-purpose equipment which comprises the Compatibility Test Assembly.

B66 Helios B–Deep Space Network Compatibility Test Summary

A. I. Bryan

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 14–24, April 15, 1976

The DSN–Helios B compatibility testing followed a very successful three-phase compatibility test program for the Helios prototype and Helios 1 spacecraft. This article covers the tests from arrival of Helios B at Cape Canaveral, Florida through launch. The compatibility tests consisted of (1) DSN–spacecraft radio frequency tests at both weak and strong signal levels, and (2) verification of radio frequency compatibility with the Helios B mated to the launch vehicle at Launch Complex 41.

B67 A Distributed Data Base Management Capability for the Deep Space Network

A. I. Bryan

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 32–36, June 15, 1976

This article reports on the Configuration Control and Audit Assembly (CCA), which has been designed to provide a distributed data base management capability for the DSN. The CCA utilizes capabilities provided by the DSN standard minicomputer and the DSN standard non-real-time high-level management-oriented programming language, MBASIC. The characteristics of the CCA for the first phase of implementation are described.

B68 DSN Mariner Jupiter–Saturn 1977 Prototype Radio Frequency Subsystem Compatibililty Status and Test Report

A. I. Bryan and B. D. Madsen

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 4–10, October 15, 1976

The DSN Mariner Jupiter–Saturn 1977 prototype Radio Frequency Subsystem compatibility tests were the first hardware and software interface tests conducted between the DSN and the Project. These tests were conducted during May 24–27, 1976 using the Compatibililty Test Area for the DSN and the Telecommunications Development Laboratory for the prototype subsystem. This report described these initial compatibility tests and reports the test results.

BRYAN, M. L.

B69 A Comparative Study of Active and Passive Microwave Imagery Over the North Slope of Alaska

M. L. Bryan (California Institute of Technology) and D. K. Hall (NASA)

Proc. Ass. Amer. Geogr. Meeting, New York, N. Y., Apr. 11–14, 1976, pp. 164–168

The microwave portion of the electromagnetic spectrum has several distinct advantages over the visible and infrared wavelengths: it can function in nearly all types of weather, and it provides a resolution independent of the distance between the sensor and the target, when used in

systems with synthetic apertures. Passive remote sensors detect radiation emitted from the earth, while active sensors generate a signal which is transmitted, reflected from the target, and received at the system antenna. The signals received from both sensors may be recorded in either digital or image format. These microwave systems were flown over the North Slope of Alaska during April 1975. The passive system, an Electrically Scanning Microwave Radiometer (ESMR) operated by Goddard Space Flight Center, is similar to that operating on the Nimbus 5 satellite. The second instrument, a synthetic aperture Side Looking Airborne Radar (SLAR), is operated by the Jet Propulsion Laboratory. This paper describes both systems used to collect the data and the visual interpretations as they relate to geomorphic and hydrologic features in the North Slope area.

B70 Imaging Radar Observations of Frozen Arctic Lakes

C. Elachi, M. L. Bryan, and W. F. Weeks (Cold Regions Research and Engineering Laboratory)

Remote Sensing Environ., Vol. 5, No. 3, pp. 169–175, 1976

For abstract, see Elachi, C.

BRYANT, N. A.

B71 LUMIS Interactive Graphics Operating Instructions and System Specifications

N. A. Bryant, T. C. Yu, and A. J. Landini

Special Publication 43-31, August 15, 1976

The LUMIS program has designed an integrated geographic information system to assist program managers and planning groups in metropolitan regions. Described is the system designed to interactively interrogate a data base, display graphically a portion of the region enclosed in the data base, and perform cross-tabulations of variables within each city block, block group, or census tract. The System is designed to interface with U. S. Census DIME file technology, but can accept alternative districting conventions. The System is described on three levels: (1) introduction to the System's concept and potential applications, (2) the method of operating the System on an interactive terminal, and (3) a detailed system specification for computer facility personnel.

B72 LUMIS, Land Use Management and Information Systems: Coordinate Oriented Program Documentation

N. A. Bryant, C. K. Paul, A. J. Landini, R. W. Bannister, and T. Logan

Special Publication 43-33, November 1, 1976

The LUMIS program has designed an integrated geographic information system to assist program managers and planning groups in metropolitan regions. Described is the series of computer software programs and procedures involved in data base construction using the census DIME file and point-in-polygon architectures. The system is described in two parts: (1) instructions to operators with regard to digitizing and editing procedures, and (2) application of the four data base construction algorithms: ROTATE (to achieve map registration), CHAIN (to assure the topological integrity of polygon files), DACS (DIME AREA CENTROID SYSTEM alternative to CHAIN), and PIOS (the polygon intersection overlay system for tabulating land use acreages within administrative districts).

BUCHANAN, H. R.

B73 Temperature Effects on Transmission Line Phase and Group Delay

H. R. Buchanan and A. L. Price

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 296–300, April 15, 1976

An investigation of the phase and group delay stability of various coaxial and waveguide transmission lines has been initiated. The purpose of the test is to determine the feasibility of separating the receiver–exciter equipment from the tricone area of the 64-meter antenna. Initial test results are reported from both controlled environment and field operating environment experiments.

BUEHLER, M. F.

B74 The Levels of Edit

R. Van Buren and M. F. Buehler

Special Publication 43-28, March 1976

For abstract, see Van Buren, R.

BURKE, E. S.

B75 Helios Mission Support

P. S. Goodwin, E. S. Burke, and R. E. Morris

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 28–34, December 15, 1976

For abstract, see Goodwin, P. S.

BURNETT, D. S.

B76 Thorium–Uranium Fission Radiography

E. L. Haines, J. R. Weiss, D. S. Burnett (California Institute of Technology), and D. S. Woolum (California Institute of Technology)

Nucl. Instrum. Methods, Vol. 135, No. 1, pp. 125–131, May 15, 1976

For abstract, see Haines, E. L.

BURUM, D. P.

B77 Extraction of Quadrature Phase Information From Multiple Pulse NMR Signals

W. K. Rhim, D. P. Burum (California Institute of Technology), and R. W. Vaughan (California Institute of Technology)

Rev. Sci. Instrum., Vol. 47, No. 6, pp. 720–725, June 1976

For abstract, see Rhim, W. K.

BUTMAN, S. A.

B78 Foldover Effects on Viterbi Decoding

J. K. Omura and S. A. Butman

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 27–32, August 15, 1976

For abstract, see Omura, J. K.

B79 Design Criteria for Noncoherent Gaussian Channels With MFSK Signaling and Coding

S. A. Butman, I. Bar-David (Israel Institute of Technology), B. K. Levitt, R. F. Lyon (Stanford Telecommunications, Inc.), and M. J. Klass (University of California, Berkeley)

IEEE Trans. Commun., Vol. COM-24, No. 10, pp. 1078–1088, October 1976

This paper presents data and criteria to assess and guide the design of modems for coded noncoherent communication systems subject to practical system constraints of power S, bandwidth W, noise spectral density N_0, coherence time T_c, and number of orthogonal signals M. Three basic receiver types are analyzed for the noncoherent multifrequency-shift keying (MFSK) additive white Gaussian noise channel: hard decision, unquantized (optimum), and quantized (soft decision). Channel capacity and computational cutoff rate R_{comp} are computed for each type and presented as functions of the predetection signal-to-noise ratio ST/N_0 and the number of orthogonal signals $M = 2TW$. This relates the channel constraints of power, bandwidth, coherence time, and noise power to the optimum choice of signal duration $T \leq T_c$ and signal number M.

B80 Linear Feedback Rate Bounds for Regressive Channels

S. A. Butman

IEEE Trans. Inform. Theor., Vol. IT-22, No. 3, pp. 363–366, May 1976

This article presents new tighter upper bounds on the rate of Gaussian autoregressive channels with linear feedback. A remarkably close agreement was found between the upper and lower bounds of the linear system, thus leading to the conjecture that the lower bound is the feedback capacity.

CALLAHAN, P. S.

C01 Columnar Content Measurements of the Solar-Wind Turbulence Near the Sun

P. S. Callahan

Astrophys. J., Vol. 199, No. 1, pp.227–236, July 1, 1975

The solar-wind turbulence near the Sun is investigated with data obtained near the superior conjunctions of Mariners 6, 7, and 9. The data are time histories of the change in the electron columnar content between the Earth and the spacecraft. It is found that the comoving turbulence spectrum is well represented by a power law $[P(\nu) \alpha \nu^{-\beta}]$ of index $\beta = 3.9 \pm 0.2$. Comparison of the average spectral amplitude near the Sun ($r \cong 0.15$ AU) with that near 1 AU shows that the turbulence declines with heliocentric distance as $\Delta n(r) \alpha r^{-2.38 \pm 0.11}$, ignoring time variations. In the region near the Sun ($0.07 \lesssim r \lesssim 0.22$ AU), $\Delta n(r)$ declines more slowly. It is suggested that there is a region of enhanced turbulence near the Sun. The Mariner 9 spectral amplitudes correlate with Zurich sunspot number. The relationship of the present observations to theories of solar-wind heating is discussed.

CANNON, A. R.

C02 Computation of Spacecraft Signal Raypath Trajectories Relative to the Sun

A. R. Cannon and C. T. Stelzried

The Deep Space Network: May and June 1976,
DSN Progress Report 42-34, pp. 33–38,
August 15, 1976

An updated double-precision computer program has been developed to determine the trajectory of a spacecraft telemetry signal raypath relative to the sun. Using trajectory information available on DPTRAJ save tapes, the program efficiently and accurately computes the desired raypath trajectory and delivers the results in the form of plots, punched cards, and a tabular listing.

CANNON, W. A.

C03 Propellant/Material Compatibility Program and Results

L. R. Toth, W. A. Cannon, C. D. Coulbert, and H. R. Long

Technical Memorandum 33-779, August 15, 1976

For abstract, see Toth, L. R.

CARAPELLUCCI, P. A.

C04 Diffusion in Mixed Solvents. 3. The Heat of Mixing Parameter and the Soret Coefficient

P. A. Carapellucci

J. Amer. Chem. Soc., Vol. 98, No. 10, pp. 3016–3018, May 12, 1976

This Communication to the Editor presents new evidence which demonstrates that for aqueous glycerol solutions the Soret coefficient of glycerol is an integral part of the heat of mixing parameter.

C05 Diffusion in Mixed Solvents. II. The Heat of Mixing Parameter

P. A. Carapellucci

J. Phys. Chem., Vol. 79, No. 25, pp. 2768–2773, December 4, 1975

Anomalous diffusion properties of iodine and reactants of various chemical reactions in binary solvents are often observed. Correlation of second-order rate constants for many reactions involving electron transfer between organic molecules, solvated electron reactions, iodine diffusion coefficients, and triplet state electron transfer reactions has been made with the heat of mixing parameter (HMP) for the aqueous binary solvent systems. The aqueous binary solvents studied are those containing methanol or ethanol (type I solvent); 1-propanol or *tert*-butyl alcohol (type II solvent); or sucrose or glycerol (type III solvent). A plot of the HMP vs. the diffusion parameter for each reaction yields superimposable curves for these reactions in a particular solvent mixture over the entire solvent mixture range, irrespective of the value of the reaction's rate constant or diffusion coefficient in water. The HMP is either $\Delta H^M/X_1X_2$ or $(\partial\Delta H^M/\partial n_2)/X_2$, where the subscript 2 refers to water, depending on the relative solubilities of the diffusing species in the components of the solvent system. The diffusion parameter, against which HMP is plotted, is $k\epsilon\eta/(k\epsilon\eta)_w$, where k refers to the second-order rate constant or diffusion coefficient, ϵ the dielectric constant, and η the viscosity; w refers to those values in water. Thermal diffusion is considered important to the explanation of these correlations, and to the theory of diffusion and kinetics in general.

CARLSON, R. W.

C06 Io's Atmosphere and Ionosphere: New Limits on Surface Pressure From Plasma Models

T. V. Johnson, D. L. Matson, and R. W. Carlson (University of Southern California)

Geophys. Res. Lett., Vol. 3, No. 6, pp. 293–296, June 1976

For abstract, see Johnson, T. V.

CARPENTER, R.

C07 The Problem of Spiral Galaxies and Satellite Radio Sources

H. Arp (Hale Observatories), R. Carpenter, S. Gulkis, and M. Klein

Astrophys. J., Vol. 205, No. 3, pp. 721–727, May 1, 1976

For abstract, see Arp, H.

CARTA, D. G.

C08 Low-Order Approximations for the Normal Probability Integral and the Error Function

D. G. Carta

Math. Comput., Vol. 29, No. 131, pp. 856–862, July 1975

Rational fractions of the form $0.5/(a + bx + \ldots)^{2q}$ are used to evaluate the function of interest. Polynomials of from third to sixth order are derived which achieve absolute errors ranging from 0.01 to 0.000001 for all (real) positive x, and relative errors of from 0.1 to 0.000001 for (real) positive x less than 3.1, 4.0, and 5.2. Denominator coefficients are calculated by linearizing the rational fraction about progressively improved nominal solutions and using linear programming to solve the resulting linear minimax problems.

CARTWRIGHT, D. C.

C09 Electron-Impact Excitation of UF_6 at an Electron Energy of 20 eV in the Energy-Loss Range of 0–10 eV

A. Chutjian, S. K. Srivastava, S. Trajmar, W. Williams, and D. C. Cartwright (Los Alamos Scientific Laboratory)

J. Chem. Phys., Vol. 64, No. 11, pp. 4791–4793, June 1, 1976

For abstract, see Chutjian, A.

C10 Photoabsorption Spectrum of UF_6 by Electron Impact

S. K. Srivastava, D. C. Cartwright (Los Alamos Scientific Laboratory), S. Trajmar, A. Chutjian, and W. Williams

J. Chem. Phys., Vol. 65, No. 1, pp. 208–211, July 1, 1976

For abstract, see Srivastava, S. K.

CASTLEMAN, K. R.

C11 Computer-Assisted Karyotyping

K. R. Castleman, J. Melnyk (City of Hope National Medical Center), H. J. Frieden, G. W. Persinger (City of Hope National Medical Center), and R. J. Wall

J. Reproductive Med., Vol. 17, No. 1, pp. 53–57, July 1976

Computerized pattern recognition techniques have been applied to human chromosome analysis since the early 1960s. Large, general-purpose computer systems typically were used to develop and evaluate various approaches and techniques for automated karyotyping. This paper describes a recently developed, stand-alone, special-purpose clinical system for automated chromosome analysis. This unit is relatively small and inexpensive compared to its predecessors It is intended for use in a cytogenetics laboratory to assist in karyotyping and reduce the cost per cell analyzed. It should provide direct answers to questions about the economics and efficiency of current automation techniques in the cytogenetics laboratory.

CHAHINE, M. T.

C12 Infrared Multidetector Spectrometer for Remote Sensing of Temperature Profiles in the Presence of Clouds

H. H. Aumann and M. T. Chahine

Appl. Opt., Vol. 15, No. 9, pp. 2091–2094, September 1976

For abstract, see Aumann, H. H.

CHANEY, W. D.

C13 DSN Tracking System—Mark III-75

W. D. Chaney

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 4–13, April 15, 1976

This article provides a description of the DSN Tracking System—Mark III-75 currently in use for multimission support. Tracking functions performed by the Deep Space Stations, Ground Communications Facility, and Network Operation Control Center are given. Changes that were made to the subsystems of the DSN Tracking System—Mark III-73 to implement the DSN Tracking System—Mark III-75 are briefly described.

CHANG, K. H.

C14 Low Work Function Silicon Collector for Thermionic Converters

K. H. Chang and K. Shimada

Technical Memorandum 33-775, May 15, 1976

To improve the efficiency of present thermionic converters, the single crystal silicon was investigated as a low work function collector material. The experiments were conducted in a test vehicle which resembled an actual thermionic converter.

The test vehicle was constructed from standard stainless steel vacuum components incorporating facilities to sputter clean the collector surface, activate it, and monitor the progress of activation. The (100) oriented silicon single crystal wafers were diffusion-bonded on molybdenum blocks to form collectors. The silicon surface was activated by cesium and oxygen after careful *in situ* preparation of the surface.

Work function as low as 1.0 eV was obtained with an n-type silicon. The stabilities of the activated surfaces at elevated temperatures were tested by raising the collector temperature up to 829 K. By increasing the cesium arrival rate, it was possible to restore the originally activated low work function of the surface at elevated surface temperatures. These results, plotted in the form of the Rasor–Warner curve, have shown a behavior similar to that of metal electrode except that the minimum work function was much lower with silicon than with metals. It was also noted that the lowest work function reproduced at elevated temperatures was dependent

upon the original work function values obtained at room temperatures.

CHAO, C. C.

C15 QVLBI Doppler Demonstrations Conducted During Pioneer 11 Encounter and Solar Conjunctions

C. C. Chao

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 54–66, February 15, 1976

During the Jupiter encounter of Pioneer 11 in December 1974, a limited amount of simultaneous two-way and three-way doppler was obtained. It was demonstrated in this study that, based on a very short arc (two weeks) of differenced doppler (quasi very long baseline interferometry or QVLBI doppler), the B-plane predictions were as good as 200 km at $E - 1$ day and 400 km at $E - 3$ days. During the two solar conjunctions of Pioneer 10 and 11, which occurred in March 1975, several passes of QVLBI doppler were obtained and analyzed. The data quality of QVLBI doppler was found to be two to three times better than the conventional two-way doppler when the Sun–Earth–probe angle was less than 5 degrees.

C16 Atmospheric Water Vapor Calibrations: Radiometer Technique

F. B. Winn, S. C. Wu, G. M. Resch, C. C. Chao, O. H. von Roos, and H. S. Lau (Stanford University)

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 38–49, April 15, 1976

For abstract, see Winn, F. B.

CHASE, S. C., JR.

C17 Infrared Thermal Mapping of the Martian Surface and Atmosphere: First Results

H. H. Kieffer (University of California, Los Angeles), S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, F. D. Palluconi, G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and T. Z. Martin (University of California, Los Angeles)

Science, Vol. 193, No. 4255, pp. 780–786, August 27, 1976

For abstract, see Kieffer, H. H.

CHELSON, P. O.

C18 Reliability Simulation for Solar Electric Propulsion Missions

P. O. Chelson and E. N. Costogue

J. Spacecraft Rockets, Vol. 12, No. 12, pp. 784–786, December 1975

System tradeoffs and reliability analyses are important aspects of mission studies of candidate planetary, cometary, and geosynchronous missions with solar electric propulsion (SEP). In such missions, the requirements are so complex that simplifications become difficult if not impossible to make. Because of this and other complicating factors, analytical techniques are often insufficient for performing mission reliability tradeoff studies of alternate designs or configurations of an SEP spacecraft. This paper describes the Monte Carlo simulation method, which provides an alternative and viable method for performing many of these analyses.

CHEN, C. J.

C19 Electron Temperature Measurements in a Copper Chloride Laser Utilizing a Microwave Radiometer

E. Sovero (California Institute of Technology), C. J. Chen (California Institute of Technology), and F. E. C. Culick (California Institute of Technology)

J. Appl. Phys., Vol. 47, No. 10, pp. 4538–4542, October 1976

For abstract, see Sovero, E.

CHENETTE, D. L.

C20 Jovian Electron Bursts: Correlation With the Interplanetary Field Direction and Hydromagnetic Waves

E. J. Smith, B. T. Tsurutani, D. L. Chenette (University of Chicago), T. F. Conlon (University of Chicago), and J. A. Simpson (University of Chicago)

J. Geophys. Res., Space Phys., Vol. 81, No. 1, pp. 65–72, January 1, 1976

For abstract, see Smith, E. J.

CHEONG, E.

C21 Functional Polymeric Microspheres Based on 2-Hydroxyethyl Methacrylate for Immunochemical Studies

A. Rembaum, S. P. S. Yen, E. Cheong, S. Wallace, R. S. Molday (California Institute of Technology), I. L. Gordon (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

Macromolecules, Vol. 9, No. 2, pp. 328–336, March–April 1976

For abstract, see Rembaum, A.

CHRISTENSEN, C. S.

C22 Performance of the Square Root Information Filter for Navigation of the Mariner 10 Spacecraft

C. S. Christensen

Technical Memorandum 33-757, January 15, 1976

This report describes the use of a sequential least squares filter in the orbit determination for the Mariner Venus–Mercury (Mariner 10) spacecraft. The orbit determination strategy outlining the use of both the sequential filter and a conventional batch filter is given. Highlighted are the mission events from launch to the first Mercury encounter with emphasis on the sequential filter performance. Advantages to the mission derived from the sequential filter are pointed out.

CHUTJIAN, A.

C23 Progress Report on the Use of the Many-Body Theory in Inelastic Scattering From Atoms

H. S. Taylor (University of Southern California), A. Chutjian, and L. D. Thomas (IBM Research Laboratory)

Electron and Photon Interactions With Atoms, pp. 435–444, Plenum Publishing Corp., New York, 1976

For abstract, see Taylor, H. S.

C24 Absolute Elastic Differential Electron Scattering Cross Sections in the Intermediate Energy Region. II.—N_2

S. K. Srivastava, A. Chutjian, and S. Trajmar

J. Chem. Phys., Vol. 64, No. 4, pp. 1340–1344, February 15, 1976

For abstract, see Srivastava, S. K.

C25 Absolute Elastic Differential Electron Scattering Cross Sections in the Intermediate Energy Region. III. SF_6 and UF_6

S. K. Srivastava, S. Trajmar, A. Chutjian, and W. Williams

J. Chem. Phys., Vol. 64, No. 7, pp. 2767–2771, April 1, 1976

For abstract, see Srivastava, S. K.

C26 Electron-Impact Excitation of UF_6 at an Electron Energy of 20 eV in the Energy-Loss Range of 0–10 eV

A. Chutjian, S. K. Srivastava, S. Trajmar, W. Williams, and D. C. Cartwright (Los Alamos Scientific Laboratory)

J. Chem. Phys., Vol. 64, No. 11, pp. 4791–4793, June 1, 1976

The electron-impact excitation spectrum of UF_6 was detected at low incident electron energies. At these energies spin and/or symmetry-forbidden transitions which did not appear in photon absorption spectra are effectively excited and thus optically forbidden transitions are detected and identified.

C27 Photoabsorption Spectrum of UF_6 by Electron Impact

S. K. Srivastava, D. C. Cartwright (Los Alamos Scientific Laboratory), S. Trajmar, A. Chutjian, and W. Williams

J. Chem. Phys., Vol. 65, No. 1, pp. 208–211, July 1, 1976

For abstract, see Srivastava, S. K.

C28 Experimental–Theoretical Comparisons of $1^1S \rightarrow 3^1P$ Differential Magnetic Sublevel Cross Sections for Electron–Helium Scattering at 80 and 100 eV

A. Chutjian

J. Phys. B: At. Mol. Phys., Vol. 9, No. 10, pp. 1749–1756, July 11, 1976

Experimental normalized absolute differential cross sections (DCS) for the excitation $1^1S \rightarrow 3^1P$ in helium are reported at incident electron energies of 80 and 100 eV, and at scattering angles between 7 and 135 deg. The measurements are combined with results of recent electron–photon coincidence studies, and absolute DCS for the excitation of the magnetic sublevels 3^1P_0 and 3^1P_{+1} are obtained. These experimental sublevel cross sections, and their sum, are compared with results of recent calculations in the multichannel eikonal and distorted-wave polarized-orbital theories.

CICERONE, R. J.

C29 Stellar Occultation Measurements of Atmospheric Ozone and Chlorine From OAO 3

G. P. Riegler, J. F. Drake (Princeton University), S. C. Liu (University of Michigan), and R. J. Cicerone (University of Michigan)

J. Geophys. Res., Space Phys., Vol. 81, No. 28, pp. 4997–5001, October 1, 1976

For abstract, see Riegler, G. P.

CITRON, O. R.

C30 Institutional and Environmental Aspects of Geothermal Energy Development

O. R. Citron

Trans. Amer. Nucl. Soc., Supplement 1 to Vol. 23, pp. 41–43, March 1976

The Jet Propulsion Laboratory has been directed by NASA to develop a comprehensive plan for the rapid development of geothermal energy. The study indicated that the major constraints on the expansion of geothermal energy usage were in the province of legal, social economic, and other institutional arenas. Thus, environmental problems were examined from an institutional as well as from the technical and natural science perspective. This paper focuses on the institutional and environmental considerations determined to be of primary significance.

CLARK, T. A.

C31 Radio Source Positions From Very-Long-Baseline Interferometry Observations

T. A. Clark, et al.

Astron. J., Vol. 81, No. 8, pp. 599–603, August 1976

Accurate positions of compact radio sources have been determined from very-long-baseline interferometry (VLBI) observations based on the bandwidth-synthesis technique. The coordinates for 18 extragalactic sources were obtained from sets of observations spread over the period from April 1972 to January 1975; the scatter among the independent determinations of the source coordinates from the separate sets of observations is about 0.05 arcsec, except for the declinations of near-equatorial sources where the scatter is about 0.15 arcsec. Comparison of our positions with those determined with the Cambridge 5-km radio interferometer shows the rms scatter about the mean difference to be about 0.04 arcsec in each coordinate (no sources of low declination were in common). A similar comparison of our results with those obtained by the Jet Propulsion Laboratory from separate VLBI observations yields a slightly larger rms scatter, after exclusion of the declinations of the near-equatorial sources. We also obtained a position for the Galactic object, β Persei (Algol), which agrees well with the position given in the FK 4 catalogue: $\Delta\alpha$(VLBI – FK4) = -0.001 ± 0.007 sec and $\Delta\delta = -0.12 \pm 0.09$ arcsec.

Contributors to this article include:

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Onsala Space Observatory, Sweden: B. O. Rönnäng and O. E. H. Rydbeck

CLAYTON, R. M.

C32 Reduction of Gaseous Pollutant Emissions From Gas Turbine Combustors Using Hydrogen-Enriched Jet Fuel—A Progress Report

R. M. Clayton

Technical Memorandum 33-790, October 15, 1976

Recent progress in an evaluation of the applicability of the hydrogen-enrichment concept to achieve ultralow gaseous pollutant emissions from gas turbine combustion systems is described. The target emission indexes (g/kg fuel) for the program are 1.0 for oxides of nitrogen (as NO_2) and carbon monoxide, and 0.5 for unburned hydrocarbons. The basic concept utilizes premixed molecular hydrogen, conventional jet-fuel, and air to depress the lean flammability limit of the mixed fuel. This is shown to permit very lean combustion with its low NO_x production while simultaneously providing an increased flame stability margin with which to maintain low CO and HC emissions.

Experimental emission characteristics and selected analytical results are presented for a cylindrical research combustor designed for operation with inlet-air state conditions typical for a 30:1 compression ratio, high-bypass ratio, turbofan commercial aviation engine. The combustor was operated at simulated low, cruise, and takeoff power conditions for this class of engine. Emissions data for H_2/jet-fuel (JP-5) mixes and for jet fuel only are presented for a wide range of equivalence ratio for the low and cruise power conditions. However, lack of flameholder durability precluded operating the combustor with H_2 at the takeoff power condition. Further burner development is required to demonstrate the concept at this severe operating condition.

The ultralow-emission goals were simultaneously achieved for the cruise power condition at an average burning equivalence ratio of 0.38 using 10–12 mass % H_2

in the total fuel. The emission goals were not achievable with jet fuel alone, due to the onset of lean blowout at too high an equivalence ratio to sufficiently reduce the NO_x emission. The emission goals were not achieved simultaneously for the low power condition, but any two of the three goals were achievable in the equivalence ratio range of 0.3 to 0.4 with a relatively small residual in the third. About 15% H_2 was required.

On the basis of the present results, it is concluded that H_2-enrichment is feasible to implement, given further dedicated development. Intermediate steps in this development for the ongoing evaluation program are to improve premixing homogeneity and flameholder design. The ultimate major step is demonstrating the feasibility of on-board hydrogen generation.

COHEN, N. S.

C33 Nitramine Propellant Research

N. S. Cohen and L. D. Strand

Technical Memorandum 33-801, October 15, 1976

An extended model of the combustion of nitramine propellants is derived to account for multiple particle sizes, mixed oxidizers, and active binders. Burning rates of various nitramine propellants are reported over the pressure range from 500 psi to 50,000 psi and show effects of systematic ingredient variations. A high-pressure window bomb is utilized to observe the combustion process of these propellants by cinematography to a pressure of 6000 psi. The propellants are also extinguished by rapid decompression, and their surface and subsurface structures are studied with the aid of a scanning electron microscope. A computer program is developed to incorporate the model extensions and is applied to explain the experimental data. Parametric studies are performed with the model to formulate methods to achieve desirable burning rate characteristics in nitramine propellants. It is concluded that the model successfully describes the combustion of nitramine propellants and is a useful tool to evaluate combustion tailoring in association with propellant development efforts.

CONEL, J. E.

C34 Interpretation of Lunar Heat Flow Data

J. E. Conel and J. B. Morton

The Moon, Vol. 14, No. 2, pp. 263–289, October 1975

Lunar heat flow observations at the Apollo 15 and 17 sites can be interpreted to imply bulk U concentrations for the Moon of 5 to 8 times those of normal chondrites and 2 to 4 times terrestrial values inferred from the Earth's heat flow and the assumption of thermal steady state between surface heat flow and heat production. A simple model of nearsurface structure that takes into account the large difference in (highly insulating) regolith thickness between mare and highland provinces is considered. This model predicts atypically high local values of heat flow near the margins of mare regions—possibly a factor of 10 or so higher than the global average. A test of the proposed model using multifrequency microwave techniques appears possible wherein heat flow traverse measurements are made across mare-highland contacts. The theoretical considerations discussed here urge caution in attributing global significance to point heat-flow measurements on the Moon.

CONLON, T. F.

C35 Jovian Electron Bursts: Correlation With the Interplanetary Field Direction and Hydromagnetic Waves

E. J. Smith, B. T. Tsurutani,
D. L. Chenette (University of Chicago),
T. F. Conlon (University of Chicago), and
J. A. Simpson (University of Chicago)

J. Geophys. Res., Space Phys., Vol. 81, No. 1, pp. 65–72, January 1, 1976

For abstract, see Smith, E. J.

CONSTENLA, L. C.

C36 Precision Signal Power Measurement and Noise-Adding Radiometer Equipment

L. C. Constenla

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 90–99, April 15, 1976

A new Precision Signal Power Measurement equipment incorporating a Noise-Adding Radiometer technique has been developed for precise measurement of spacecraft signal power returns. This equipment continuously measures the receiver system noise temperature, signal-to-noise ratio, and received signal power in real time during actual spacecraft tracking. The operation of this system requires that a precisely known amount of noise be switched on and off at the receiver input. This increase in noise is detected and used as a reference in the determination of the receiver system noise temperature. In turn, the system temperature is used to calculate the received signal power.

The Precision Signal Power Measurement equipment is presently installed in the Pedestal Room of the DSN 64-m-diameter antenna at the Mars Deep Space Station (DSS 14). The system was successfully tested during the Helios track on 2 October 1975, recording an averaged

received carrier power of −140.6 dBm, which was in close agreement with the calibrated automatic gain control method used by the station.

COSTOGUE, E. N.

C37 Reliability Simulation for Solar Electric Propulsion Missions

P. O. Chelson and E. N. Costogue

J. Spacecraft Rockets, Vol. 12, No. 12, pp. 784–786, December 1975

For abstract, see Chelson, P. O.

COULBERT, C. D.

C38 Propellant/Material Compatibility Program and Results

L. R. Toth, W. A. Cannon, C. D. Coulbert, and H. R. Long

Technical Memorandum 33-779, August 15, 1976

For abstract, see Toth, L. R.

CRAWFORD, D. W.

C39 Digital Image Processing of Vascular Angiograms

R. H. Selzer, D. H. Blankenhorn (University of Southern California), E. S. Beckenbach, D. W. Crawford (University of Southern California), and S. H. Brooks (University of Southern California)

Proc. SPIE Conf. Cardiovascular Imaging and Image Processing, Theory and Practice, Stanford, Calif., July 1975, Vol. 72, pp. 159–162

For abstract, see Selzer, R. H.

CUDDIHY, E. F.

C40 Hygroscopic Properties of Magnetic Recording Tape

E. F. Cuddihy

IEEE Trans. Magnet., Vol. MAG-12, No. 2, pp. 126–135, March 1976

Relative humidity has been recognized as an important environmental factor in many head–tape interface phenomena such as headwear, friction, staining, and tape shed. Accordingly, the relative humidity is usually specified in many applications of tape use, especially when tape recorders are enclosed in hermetically sealed cases. Normally, the relative humidity is believed regulated by humidification of the fill gas to the specification relative humidity. However, this study demonstrates that the internal relative humidity in a sealed case is completely controlled by the time-dependence of the hygroscopic properties of the pack of magnetic recording tape. Procedures for the humidity conditioning of sealed cases must be established on the basis of the tapes' hygroscopic properties, and not on humidification of the fill gas. Without taking the tape into account, the final, stabilized, relative humidity can be significantly different from the specification requirement. Additionally, this same study finds differences in the hygroscopic properties of the same brand of tape, which apparently results from aging, and which may have significance on the long-term humidity-regulating behavior in a sealed case, and on the occurrence of head–tape interface phenomena from the long-term use of the tape. This article presents results on the basic hygroscopic properties of tape, its humidity-regulating behavior in a sealed case, and includes a theoretical commentary on the relative humidity dependence of headware by tape.

C41 In Vivo Degradation of Silicone Rubber Poppets in Prosthetic Heart Valves

E. F. Cuddihy, J. Moacanin, E. J. Roschke, and E. C. Harrison (University of Southern California)

J. Biomed. Mater. Res., Vol. 10, No. 3, pp. 471–481, May 1976

Dynamic shear modulus G' was measured throughout the volume of three nonvariant silicone rubber poppets which were recovered from aortic prosthetic heart valves that had been implanted for 4 days, 52 days, and 8 years. Similar measurements were obtained for two unused silicone rubber poppets. Although the recovered poppets exhibited no obvious physical evidence of damage, the silicone rubber had undergone *in vivo* degradation throughout the poppet volume as indicated by decreases in modulus. The measurements also indicate that the poppet surface degrades at a rate faster than the core. Further, comparison with data reported in the literature suggests that the surfaces of variant poppets degrade at a rate faster than the surfaces of nonvariant poppets.

C42 Solvent-Sensitivity of Biaxially Oriented Poly(Ethylene Terephthalate) Film

E. F. Cuddihy

J. Polym. Sci., Pt. B: Polym. Lett., Vol. 13, No. 10, pp. 595–601, October 1975

Biaxially oriented poly(ethylene terephthalate) PET film was found to be sensitive to solvent-stress-cracking, and susceptible to premature failure when stressed above 5860 N/cm^2 (8500 psi) in solvent environments. This stress value was concluded to be the "Environmental Stress Limit" of PET film. The extent of sensitivity to a particular solvent could be judged from comparison of

uniaxial stress-strain curves measured for test specimens in air and immersed in the solvent. Additionally, commercial films of PET were found to be mechanically anisotropic, having mechanical properties which varied as a function of angle in the plane of the film. The extent of solvent sensitivity was found to vary with this anisotropy, and led to the recognition that this anisotropy must be considered when mechanical testing is used to evaluate environmental effects on oriented PET film.

The investigation was initiated as a result of the failure of a 0.0025-cm (1-mil) thick PET belt employed in the drive train of a tape recorder intended for a space mission. The belt failed while operating during a ground test of the recorder, and a review disclosed that at some earlier time, the belt, while under tension, had been cleaned with methyl ethyl ketone (MEK) solvent. Subsequently, a laboratory analysis identified the cause of failure as flexural fatigue.

In that study, PET was flexed while simultaneously maintained under a constant tension. It was found that the number of cycles to failure was essentially constant for stress levels below 5860 N/cm^2 (8500 psi), and that the number of cycles to failure decreased rapidly with stress above 5860 N/cm^2 (8500 psi). This mechanical "Fatigue Endurance Limit" of 5860 N/cm^2 (8500 psi) is coincident with the solvent "Environmental Stress Limit." This article documents the results of the solvent studies which were carried out during the failure investigation.

CUFFEL, R. F.

C43 Density Fluctuations and Radiated Noise for a High-Temperature Supersonic Jet

S. P. Parthasarathy, P. F. Massier, R. F. Cuffel, and J. R. Radbill

Aeroacoustics: Jet Noise, Combustion and Core Engine Noise (*Progr. Astronaut. Aeronaut.*, Vol. 43), pp. 283–305, 1976

For abstract, see Parthasarathy, S. P.

C44 Shock Wave/Turbulent Boundary-Layer Interactions With and Without Surface Cooling

L. H. Back and R. F. Cuffel

AIAA J., Vol. 14, No. 4, pp. 526–532, April 1976

For abstract, see Back, L. H.

C45 Compressible Laminar Boundary Layers with Large Acceleration and Cooling

L. H. Back and R. F. Cuffel

AIAA J., Vol. 14, No. 7, pp. 968–971, July 1976

For abstract, see Back, L. H.

CULICK, F. E. C.

C46 Electron Temperature Measurements in a Copper Chloride Laser Utilizing a Microwave Radiometer

E. Sovero (California Institute of Technology), C. J. Chen (California Institute of Technology), and F. E. C. Culick (California Institute of Technology)

J. Appl. Phys., Vol. 47, No. 10, pp. 4538–4542, October 1976

For abstract, see Sovero, E.

CUNNINGHAM, R.

C47 A System for Extracting 3-Dimensional Measurements From a Stereo Pair of TV Cameras

Y. Yakimovsky and R. Cunningham

Technical Memorandum 33-769, May 15, 1976

For abstract, see Yakimovsky, Y.

C48 DABI—A Data Base for Image Analysis With Nondeterministic Inference Capability

Y. Yakimovsky and R. Cunningham

Technical Memorandum 33-773, May 15, 1976

For abstract, see Yakimovsky, Y.

C49 On the Problem of Embedding Picture Elements in Regions

Y. Yakimovsky and R. Cunningham

Technical Memorandum 33-774, June 1, 1976

For abstract, see Yakimovsky, Y.

DALLAS, S. S.

D01 The Motion of a Satellite in Resonance with the Longitude-Dependent Harmonics

S. S. Dallas

J. Astronaut. Sci., Vol. XXIV, No. 2, pp. 97–110, April–June 1976

The solution to the motion of a satellite in an eccentric orbit and in resonance with one or more of the longitude-dependent harmonics of the central planet is developed. The method of solution parallels the well known von Zeipel method of general perturbations. The solution consists of expressions for the variations of the Delaunay variables. These expressions are composed of the perturbations developed by Brouwer in 1959 for the motion of an artificial satellite plus first-order resonant perturbations due to longitude-dependent harmonics (in

terms of Legendre normal elliptic integrals of the first and second kind).

DATTA, T.

D02 The Electrical and Magnetic Properties of $(TTF)(I)_{0.71}$

R. B. Somoano, A. Gupta, V. Hadek, T. Datta (Tulane University), M. Jones (Tulane University), R. Deck (Tulane University), and A. M. Hermann (Tulane University)

J. Chem. Phys., Vol. 63, No. 11, pp. 4970–4976, December 1, 1975

For abstract, see Somoano, R. B.

DAVIES, D. W.

D03 Viking: Mars Atmospheric Water Vapor Mapping Experiment—Preliminary Report of Results

C. B. Farmer, D. W. Davies, and D. D. LaPorte (Santa Barbara Research Center)

Science, Vol. 193, No. 4255, pp. 776–780, August 27, 1976

For abstract, see Farmer, C. B.

DAVIS, H. S.

D04 Improved Space Radiation Shielding Methods

H. S. Davis and T. M. Jordan

Technical Memorandum 33-765, March 1, 1976

The computing software that was used to perform the charged particle radiation transport analysis and shielding design for the Mariner Jupiter/Saturn 1977 spacecraft is described. Electron fluences, energy spectra, and dose rates obtained with this software are presented and compared with independent computer calculations.

DECK, R.

D05 The Electrical and Magnetic Properties of $(TTF)(I)_{0.71}$

R. B. Somoano, A. Gupta, V. Hadek, T. Datta (Tulane University), M. Jones (Tulane University), R. Deck (Tulane University), and A. M. Hermann (Tulane University)

J. Chem. Phys., Vol. 63, No. 11, pp. 4970–4976, December 1, 1975

For abstract, see Somoano, R. B.

DELSARTE, P.

D06 Zeros of Functions in Finite Abelian Group Algebras

P. Delsarte (MBLE Research Laboratory) and R. J. McEliece

Amer. J. Math., Vol. 98, No. 1, pp. 197–224, 1976

This paper studies the p-adic behavior of $N(f)$ as f varies through a fixed ideal of the group algebra $K[A]$.

DeMORE, W. B.

D07 Interagency Comparison of Iodometric Methods for Ozone Determination

W. B. DeMore, J. C. Romanovsky (Environmental Protection Agency), M. Feldstein (Bay Area Air Pollution Control District, San Francisco), W. J. Hamming (Los Angeles County Air Pollution Control District), and P. K. Mueller (Environmental Research and Technology, Inc.)

Calibration in Air Monitoring, ASTM STP 598, American Society for Testing and Materials, pp. 131–143, 1976

In 1973 it was learned that measurements of oxidants by the Los Angeles Air Pollution Control District (LAAPCD) were about 30 percent lower than measurements by the California Air Resources Board (ARB) and that the discrepancy was due to differences in the calibration methods of the two agencies. To resolve this problem, the ARB appointed an Oxidant Calibration Committee for the purpose of evaluating the accuracy of the different agency calibration procedures. The committee selected ultraviolet absorption photometry as the reference method for ozone measurement. Interagency comparisons of the various iodometric methods were conducted relative to the ultraviolet standard. The tests included versions of the iodometric methods as employed by ARB, LAAPCD, and the Environmental Protection Agency (EPA). An alternative candidate reference method for ozone measurement, gas phase titration, was also included in the test series. Under the conditions of these tests, which were considered to be representative of procedures employed by the California agencies, the ARB method read high by 25 to 30 percent, and the LAAPCD method read low by about 4 percent. The EPA method, which is similar to the ARB method, also read high. The gas phase titration results were about 9 percent higher than the reference ultraviolet standard. Based on the results of these tests and other considerations, the committee has recommended that future ozone calibration procedures in the State of California be referenced to an ultraviolet standard.

D08 **Rate Constants at 295 K for the Reactions of Atomic Chlorine With H_2O_2, HO_2, O_3, CH_4 and HNO_3**

M. T. Leu and W. B. DeMore

Chem. Phys. Lett., Vol. 41, No. 1, pp. 121–124, July 1, 1976

For abstract, see Leu, M. T.

D09 **Comparison of Ozone Determinations by Ultraviolet Photometry and Gas-Phase Titration**

W. B. DeMore and M. Patapoff

Environ. Sci. Technol., Vol. 10, No. 9, pp. 897–899, September 1976

A comparison of ozone determinations based on ultraviolet absorption photometry and gas-phase titration (GPT) shows good agreement between the two methods. Together with other results, these findings indicate that three candidate reference methods for ozone, UV photometry, IR photometry, and GPT are in substantial agreement. However, the GPT method is not recommended for routine use by air pollution agencies for calibration of ozone monitors because of susceptibility to experimental error.

DIVINE, N.

D10 **Consideration of Probability of Bacterial Growth for Jovian Planets and Their Satellites**

D. M. Taylor, R. M. Berkman, and N. Divine

Life Sciences and Space Research XIII, pp. 111–118, Akademie-Verlag, Berlin, 1975

For abstract, see Taylor, D. M.

DORMAN, J.

D11 **High-Efficiency Solar Concentrator**

F. L. Lansing and J. Dorman

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 99–109, October 15, 1976

For abstract, see Lansing, F. L.

DOUGLAS, S.

D12 **Radiation Design Criteria Handbook**

A. G. Stanley, K. E. Martin, and S. Douglas

Technical Memorandum 33-763, August 1, 1976

For abstract, see Stanley, A. G.

DOWNS, G. S.

D13 **A Radar Study of the Backup Martian Landing Sites**

G. S. Downs, R. R. Green, and P. E. Reichley

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 49–52, December 15, 1976

The Goldstone radar system at DSS 14 was used to probe the Martian surface at 8495 MHz in a narrow strip between −6 deg and −2 deg latitude. The Viking C landing sites lie in this strip, and their altitudes, rms surface slope, and reflectivity are presented here.

D14 **Radar Measurements of Martian Topography and Surface Properties: The 1971 and 1973 Oppositions**

G. S. Downs, P. E. Reichley, and R. R. Green

Icarus, Vol. 26, No. 3, pp. 273–312, November 1975

The Goldstone radar system was used at a wavelength of 12.6 cm to probe the Martian surface during the 1973 opposition. Measurements of range and reflected power were made at least weekly between July 12 and November 24. Surface cells isolated by the radar system were 8 km E–W × 110 km N–S. Altitudes were calculated from signal time delays measured relative to a triaxial ellipsoid and were combined with altitudes measured during the 1971 opposition. Contours of constant altitude were calculated at 200 m intervals between latitudes −14° and −22°. These contours are presented in conjunction with Mars charts derived from Mariner 9 television pictures. Reflected power was measured at angles of incidence between −5° and +5°. These measurements were combined with those obtained during the 1971 opposition. Predictions of the reflected power versus the angle of incidence were calculated from the exponential surface model of Hagfors. The predictions were fit to the data in a least-squares sense, using a nonlinear iterative procedure, to yield estimates of surface roughness and reflectivity. The smoother regions exhibit a typical reflectivity of 8.2%. A tendency for the reflectivity to decrease with increasing roughness was observed.

DRAKE, J. F.

D15 **Stellar Occultation Measurements of Atmospheric Ozone and Chlorine From OAO 3**

G. P. Riegler, J. F. Drake (Princeton University), S. C. Liu (University of Michigan), and R. J. Cicerone (University of Michigan)

J. Geophys. Res., Space Phys., Vol. 81, No. 28, pp. 4997–5001, October 1, 1976

For abstract, see Riegler, G. P.

DREYER, W. J.

D16 Functional Colloidal Particles for Immunoresearch

S. P. S. Yen, A. Rembaum, R. S. Molday (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

ACS 169th National Meeting on Emulsion Polymerization, Philadelphia, Pensylvania, April 6–11, 1975 (ACS Symposium Series, No. 24), pp. 236–257

For abstract, see Yen, S. P. S.

D17 New Immunolatex Spheres: Visual Markers of Antigens on Lymphocytes for Scanning Electron Microscopy

R. S. Molday (California Institute of Technology), W. J. Dreyer (California Institute of Technology), A. Rembaum, and S. P. S. Yen

J. Cell Biol., Vol. 64, No. 1, pp. 75–88, January 1975

For abstract, see Molday, R. S.

D18 Functional Polymeric Microspheres Based on 2-Hydroxyethyl Methacrylate for Immunochemical Studies

A. Rembaum, S. P. S. Yen, E. Cheong, S. Wallace, R. S. Molday (California Institute of Technology), I. L. Gordon (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

Macromolecules, Vol. 9, No. 2, pp. 328–336, March–April 1976

For abstract, see Rembaum, A.

D19 Latex Spheres as Markers for Studies of Cell Surface Receptors by Scanning Electron Microscopy

R. S. Molday (California Institute of Technology), W. J. Dreyer (California Institute of Technology), A. Rembaum, and S. P. S. Yen

Nature, Vol. 249, No. 5452, pp. 81–83, May 3, 1974

For abstract, see Molday, R. S.

DUTT, B.

D20 Effect of Internal Temperature Fluctuations on Noise Production and Transmission of Pressure Fluctuations to the Far Field

S. P. Parthasarathy, B. Dutt, and P. F. Massier

Preprint 76-580, AIAA Third Aero-Acoust. Conf., Palo Alto, Calif., July 20–23, 1976

For abstract, see Parthasarathy, S. P.

DUXBURY, J. H.

D21 Interplanetary Spacecraft Design Using Solar Electric Propulsion

J. H. Duxbury and G. M. Paul

J. Spacecraft Rockets, Vol. 13, No. 2, pp. 99–105, February 1976

Emphasis of the NASA electric propulsion technology program is now on the application of solar electric propulsion to scientific missions. Candidate planetary, cometary, and geosynchronous missions are being studied. The object of this paper is to describe a solar electric propulsion spacecraft design proposed as the means to accomplish a comet slow flyby, a comet rendezvous, and an out-of-the-ecliptic mission. The discussion includes design differences foreseen for these missions and indicates those areas where spacecraft design commonality is possible. Particular emphasis is placed on a solar electric propulsion module concept which permits an attractive degree of design inheritance from mission to mission.

D22 Jupiter Orbiter Mother/Daughter Spacecraft Concept

J. H. Duxbury

J. Spacecraft Rockets, Vol. 13, No. 5, pp. 259–260, May 1976

The initial phase of the NASA Outer Planets Exploration Program is focusing on Jupiter. Pioneers 10 and 11 have recently obtained some limited imaging and environmental coverage of the planet indicating that the field strengths, particle fluxes, and their directions may be subject to large temporal variations. Unless these environmental conditions are measured in at least two locations simultaneously, the suspected temporal variations cannot be separated unambigously from the spatial variations. This paper describes a Jupiter orbiter mother/daughter spacecraft concept that would employ two independent spacecraft to perform these simultaneous measurements and thus distinguish between the spatial and temporal variations of the field strengths and particle fluxes. In this concept, the mother spacecraft would, in addition, perform remote sensing of Jupiter and its natu-

ral satellites. The paper also provides a detailed description of the daughter spacecraft.

DUXBURY, T. C.

D23 The Motions of Phobos and Deimos From Mariner 9 TV Data

G. H. Born and T. C. Duxbury

Celest. Mech., Vol. 12, No. 1, pp. 77–88, August 1975

For abstract, see Born, G. H.

DYER, J. S.

D24 An Actual Application of Collective Choice Theory to the Selection of Trajectories for the Mariner Jupiter/Saturn 1977 Project

J. S. Dyer (University of California, Los Angeles) and R. F. Miles, Jr.

Oper. Res., Vol. 24, No. 2, pp. 220–244, March–April 1976

This paper describes the use of decision analysis to facilitate a group decision-making problem in the selection of trajectories for the two spacecraft of the Mariner Jupiter/Saturn 1977 Project. This NASA project includes the participation of some 80 scientists, divided by specialization among 11 science teams. A set of 32 candidate trajectory pairs was developed by the project, in collaboration with the science teams. Each science team then ordinally ranked and assigned cardinal utility function values to the trajectory pairs. The scientists used these data and statistics derived from collective choice rules in selecting the preferred trajectory pair.

EDELSON, R. E.

E01 An Observational Program to Search for Radio Signals From Extraterrestrial Intelligence Through the Use of Existing Facilities

R. E. Edelson

Preprint IAF-A-76-033, Int. Astronaut. Fed. XXVII Congress, Anaheim, Calif., Oct. 10–16, 1976

Approaches to the detection of radio signals from extraterrestrial intelligence (ETI) have, of necessity, circumscribed the vast parameter space which might be searched. Uncertainties in location, frequency, modulation, and reasonable power flux density have drawn arguments for huge antennas and philosophical approaches to frequency selection. Yet, the observational limits within which ETI signals might await detection are largely undefined. The state-of-the-art has advanced so that observations with existing antennas, equipped with modern data processors, can define limits over very broad frequency ranges in reasonable observational times. A modest program has been initiated to search for ETI signals from 1 to 25 GHz over 80% of the sky to flux levels from 10^{-19} to 10^{-23} W/m^2.

EGAN, W. G.

E02 Complex Refractive Index of Martian Dust: Mariner 9 Ultraviolet Observations

K. D. Pang, J. M. Ajello, C. W. Hord (University of Colorado), and W. G. Egan (Grumman Aerospace Corporation)

Icarus, Vol. 27, No. 1, pp. 55–67, January 1976

For abstract, see Pang, K. D.

EISENMAN, A. R.

E03 Optical Guidance Vidicon Test Program Final Report

A. R. Eisenman, R. H. Stanton, and C. C. Voge

Technical Memorandum 33-796, September 15, 1976

A laboratory and field test program was conducted to quantify optical-navigation parameters of Mariner vidicons. A scene simulator and a camera were designed and built for vidicon tests under a wide variety of conditions. Laboratory tests characterized error sources important to the optical-navigation process and field tests verified star sensitivity and characterized comet optical guidance parameters. The equipment, tests, and data reduction techniques used are described. Key test results are listed. A substantial increase in the understanding of the use of selenium vidicons as detectors for spacecraft optical guidance was achieved, indicating a reduction in residual offset errors by a factor of two to four to the single pixel level.

ELACHI, C.

E04 Wave Patterns Across the North Atlantic on September 28, 1974, From Airborne Radar Imagery

C. Elachi

J. Geophys. Res., Vol. 81, No. 15, pp. 2655–2656, May 20, 1976

Airborne coherent radar imagery taken during a cross-Atlantic flight was used to determine the two-dimensional wave pattern of waves on a path across the North Atlantic on September 28, 1974. The radar imagery was compared to ship reports and to photographs taken during the part of the flight when no clouds were present.

The wave images were related to the presence of two major storm areas in the North Atlantic just before flight time.

E05 Radar Imaging of Ocean Surface Patterns

W. E. Brown, Jr., C. Elachi, and T. W. Thompson

J. Geophys. Res., Vol. 81, No. 15, pp. 2657–2667, May 20, 1976

For abstract, see Brown, W. E., Jr.

E06 Floquet and Coupled-Waves Analysis of Higher-Order Bragg Coupling in a Periodic Medium

D. L. Jaggard and C. Elachi

J. Opt. Soc. Amer., Vol. 66, No. 7, pp. 674–682, July 1976

For abstract, see Jaggard, D. L.

E07 Imaging Radar Observations of Frozen Arctic Lakes

C. Elachi, M. L. Bryan, and W. F. Weeks (Cold Regions Research and Engineering Laboratory)

Remote Sensing Environ., Vol. 5, No. 3, pp. 169–175, 1976

L-band radar images of a number of ice-covered lakes located approximately 48 km northwest of Bethel, Alaska show large differences in radar backscatter with lakes showing homogeneous low returns, homogeneous high returns and/or low returns around the lake borders and high returns from the central areas. The patterns of the returns suggest that a low return indicates that the lake is frozen completely to its bottom while a high return indicates the presence of fresh water between the ice cover and the lake bed. This interpretation is in good agreement with the limited information available on lake depths in the study area, and recent X-band radar observations of North Slope lakes by Sellman, Weeks and Campbell who suggested such an interpretation. These effects are, however, more striking in the L-band than in the X-band imagery. This can be explained by the fact that volume inhomogeneities, such as air bubbles, will cause more scattering and conductivity losses and thus more attenuation at the shorter wavelengths (X-band, 3 cm).

E08 Lunar Cartography With the Apollo 17 ALSE Radar Imagery

M. F. Tiernan, L. E. Roth, T. W. Thompson, C. Elachi, and W. E. Brown, Jr.

The Moon, Vol. 15, Nos. 1/2, pp. 155–163, January/February 1976

For abstract, see Tiernan, M. F.

EMERSON, R. F.

E09 Biplexed Pipelined FFT

R. F. Emerson

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 54–59, August 15, 1976

A method of implementing a pipelined fast Fourier transform (FFT) that makes full use of the elements that comprise it is presented. For a given bandwidth and spectral resolution this approach requires 25 percent less memory, and needs only half the logic speed required for the conventional implementation. Since the spectrum is broken into two parts, two analog-to-digital converters, and attendant mixer-filters, are needed. These two input elements need only operate at half the speed of the one they replace.

E10 Command Detector SNR Estimator and Lock Status Monitor Circuitry

R. F. Emerson

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 42–51, October 15, 1976

A breadboard of the command detector signal-to-noise-ratio estimator and lock status monitor was built on a wire-wrap card. The breadboard was integrated with the Standard Command Detector, and its performance was measured. The design, design constraints, and construction of the breadboard are described. The performance is shown to agree with the theoretical model.

ENARI, D. M.

E11 Network Loading Visibility for Management

D. M. Enari and C. A. Holritz

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 128–131, February 15, 1976

The responsibilities of the Deep Space Network (DSN) Operations Scheduling Group (NOSG) are outlined. The long-range scheduling portion of the NOSG is explained in detail. Examples of the DSN Forecast, published quarterly by the NOSG, are also included.

ERNEST, F. P.

E12 Practical Antireflection Coatings for Metal-Semiconductor Solar Cells

Y. C. M. Yeh, F. P. Ernest, and R. J. Stirn

J. Appl. Phys., Vol. 47, No. 9, pp. 4107–4112, September 1976

For abstract, see Yeh, Y. C. M.

ESCOBAL, P. R.

E13 Advanced Multilateration Theory, Software Development, and Data Processing: The MICRODOT System

P. R. Escobal, J. F. Gallagher (Computer Sciences Corp.), and O. H. von. Roos

Technical Memorandum 33-792, July 4, 1976

The main body of this report consists of a summary overview wherein the process of geometric parameter estimation to accuracies of one centimeter, i.e., multilateration, is defined and applications listed. A brief functional explanation of the theory is presented with all derivations placed in the appendices. Next, various multilateration sytems are described in order of increasing system complexity. Expected systems accuracy is discussed from a general point of view and a summary of the errors is listed. An outline of the design of a software processing system for multilateration, herein called MICRODOT, is presented next. The links of this software, which can be used for multilateration data simulations or operational data reduction, are examined on an individual basis. Functional flow diagrams are presented to aid in understanding the software capability. MICRODOT capability is described with respect to vehicle configurations, interstation coordinate reduction, geophysical parameter estimation, and orbit determination.

ESKENAZI, R.

E14 RAPID—A Random Access Picture Digitizer, Display, and Memory System

Y. Yakimovsky, M. Rayfield, and R. Eskenazi

Technical Memorandum 33-772, May 15, 1976

For abstract, see Yakimovsky, Y.

ESPOSITO, P. B.

E15 Experimental Test of General Relativity Using Time-Delay Data From Mariner 6 and Mariner 7

J. D. Anderson, P. B. Esposito, W. L. Martin, C. L. Thornton, and D. O. Muhleman (California Institute of Technology)

Astrophys. J., Vol. 200, No. 1, pp. 221–233, August 15, 1975

For abstract, see Anderson, J. D.

ESTABROOK, F. B.

E16 Response of Doppler Spacecraft Tracking to Gravitational Radiation

F. B. Estabrook and H. D. Wahlquist

Gen. Relat. Grav., Vol. 6, No. 5, pp. 439–447, October 1975

A calculation is made of the effect of gravity waves on the observed doppler shift of a sinusoidal electromagnetic signal transmitted to, and transponded from, a distant spacecraft. We find that the effect of plane gravity waves on such observations is not intuitively immediate and in fact can have surprisingly different spectral signatures for different spacecraft directions and distances. We suggest the possibility of detecting such plane waves by simultaneous coherent doppler tracking of several spacecraft.

E17 Prolongation Structures of Nonlinear Evolution Equations. II

F. B. Estabrook and H. D. Wahlquist

J. Math. Phys. (N. Y.), Vol. 17, No. 7, pp. 1293–1297, July 1976

The prolongation structure of a closed ideal of exterior differential forms is further discussed, and its use illustrated by application to an ideal (in six dimensions) representing the cubically nonlinear Schrödinger equation. The prolongation structure in this case is explicitly given, and recurrence relations derived which support the conjecture that the structure is open (i.e., does not terminate as a set of structure relations of a finite-dimensional Lie group). We introduce the use of multiple pseudopotentials to generate multiple Bäcklund transformation, and derive the double Bäcklund transformation. This symmetic transformation concisely expresses the (usually conjectured) theorem of permutability, which must consequently apply to all solutions irrespective of asymptotic constraints.

ESTABROOK, W. C.

E18 System Design for a Nuclear Electric Spacecraft Utilizing Out-of-Core Thermionic Conversion

W. C. Estabrook, W. M. Phillips, and T. Hsieh

Technical Memorandum 33-791, September 1, 1976

A nuclear power system under investigation at the Jet Propulsion Laboratory utilizes heat pipes to transport thermal power from a fast spectrum nuclear reactor to a thermionic converter array. Conversion of nuclear thermal power to electric power in quantities large enough to provide primary propulsion is of interest for advanced

spacecraft. This effort at JPL with the cooperation of the Los Alamos Scientific Laboratory is directed toward determining the feasibility of a heat pipe reactor concept to transfer heat to out-of-core thermionics as an alternate to the in-core thermionics concept previously investigated by Gulf General Atomics. The principal advantage of this approach is to eliminate nuclear fuel burn-up interactions with the thermionic converters and also allow the thermionics to be removed from the hostile environment of the reactor. This report addresses the basic guidelines for the nuclear reactor, heat pipes, thermionic converters, shields (neutron and gamma), waste heat rejection system, and the electrical bus bar-cable system required to transport the high current/low voltage power to the processing equipment.

FANALE, F. P.

F01 Martian Volatiles: Their Degassing History and Geochemical Fate

F. P. Fanale

Icarus, Vol. 28, No. 2, pp. 179–202, June 1976

Observations of Mars and cosmochemical considerations imply that the total inventory of degassed volatiles on Mars is 100 to 1000 times that present in Mars' atmosphere and polar caps. The degassed volatiles have been physically and chemically incorporated into a layer of unconsolidated surface rubble (a "megaregolith") up to 2 km thick. Tentative lines of evidence suggest a high concentration of ^{40}AR in the atmosphere of Mars. If correct, this would be consistent with a degassing model for Mars in which the Martian "surface" volatile inventory is presumed identical to that of Earth but scaled to Mars' smaller mass and surface area. Such a model is useful for testing, but differences in composition and planetary energy history may be anticipated between Mars and Earth on theoretical grounds. Also, the model demands huge regolith sinks for the volatiles listed.

F02 Space Exploration and the History of Solar-System Volatiles

F. P. Fanale

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 183–198, July 1976

The assemblage of volatiles degassed from each planetary object simultaneously reflects the preaccretion history of the solid solar-system material which accreted to produce that object and the internal differentiation history of the object. The key questions are: 1) What are the differences in bulk composition among planetary objects and how did they arise? and 2) How have volatiles within each object been redistributed among its interior, its surface, and its atmosphere?—a) What is the total volatile inventory which was degassed to each surface? b) When did supply occur and what were the energy sources? and c) What was the geochemical fate of each constituent? In comparative studies of planetary-surface and atmospheric volatiles, one of the hardest problems is disentangling differences among planetary-surface volatile inventories which are due to initial differences in bulk composition among objects from those due to differences in subsequent internal differentiation and atmospheric history. In the area of internal differentiation and degassing, the greatest puzzles involve understanding apparent differentiation of surprisingly small objects and surprisingly early differentiation of both large and small objects.

The answers to these questions are most efficiently obtained by a balanced program of space exploration which includes strong mission-supporting programs of Earth-based observations, theoretical studies, and laboratory experiments. The study of "planetary atmospheres" cannot be undertaken in isolation from studies of other important sinks for degassed volatiles. It is concluded that a highly selective program should emphasize: 1) analysis of the elemental and isotopic composition of rare gas in planetary atmospheres; 2) assay of volatile-containing phases in planetary regoliths; and 3) evaluation of conditions related to present or past atmospheric escape/accretion processes.

FANSELOW, J. L.

F03 A Demonstration of an Independent-Station Radio Interferometry System With 4-cm Precision on a 16-km Base Line

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, L. J. Skjerve, D. J. Spitzmesser, and H. F. Fliegel

J. Geophys. Res., Vol. 81, No. 5, pp. 995–1005, February 10, 1976

For abstract, see Thomas, J. B.

FARMER, C. B.

F04 Spectroscopic Detection and Vertical Distribution of HCl in the Troposphere and Stratosphere

C. B. Farmer, O. F. Raper, and R. H. Norton

Geophys. Res. Lett., Vol. 3, No. 1, pp. 13–16, January 1976

HCl has been observed in both the troposphere and stratosphere from ground-based and airborne spectroscopic measurements of the 1-0 band at 3-micron wavelength. The results, which are specific to the HCl molecule in the gas phase, show a decreasing mixing ratio with altitude in the lower stratosphere. The stratospheric layer, which commences at about 15 km, reaches its maximum concentration at an altitude above 21 km (the

limiting height of the observations to date). The local value for the volume mixing ratio at 21 km is $7 \pm 1 \times 10^{-10}$. However, the zenith column abundance observed above 21 km (6.3×10^{14} mols cm^{-2}) implies that the mixing ratios at greater altitudes are unlikely to reach values much in excess of the local value at 21 km.

F05 Viking: Mars Atmospheric Water Vapor Mapping Experiment—Preliminary Report of Results

C. B. Farmer, D. W. Davies, and D. D. LaPorte (Santa Barbara Research Center)

Science, Vol. 193, No. 4255, pp. 776–780, August 27, 1976

Observations made from the Viking 1 orbiter show very little water vapor in the Mars atmosphere in the southern hemisphere (0 to 3 precipitable micrometers) with a gradual increase across the equator to northern latitudes. Maximum amounts between 20 and 30 micrometers have been observed in the short period covered by the observations to date. The season, northern midsummer, corresponds to the beginning of the water vapor cycle in that hemisphere. A strong repetitive diurnal cycling between the solid and vapor phases is observed at a site to the east of the Tharsis Ridge at 10° north latitude, the vapor lies close to the martian surface and is most probably in saturation equilibrium with a surface haze or fog throughout much of the day.

FAVERO, M. S.

F06 Method for Collecting Naturally Occurring Airborne Bacterial Spores for Determining Their Thermal Resistance

J. R. Puleo, M. S. Favero, G. S. Oxborrow, and C. M. Herring

Appl. Microbiol., Vol. 30, No. 5, pp. 786–790, November 1975

For abstract, see Puleo, J. R.

FELDSTEIN, M.

F07 Interagency Comparison of Iodometric Methods for Ozone Determination

W. B. DeMore, J. C. Romanovsky (Environmental Protection Agency), M. Feldstein (Bay Area Air Pollution Control District, San Francisco), W. J. Hamming (Los Angeles County Air Pollution Control District), and P. K. Mueller (Environmental Research and Technology, Inc.)

Calibration in Air Monitoring, ASTM STP 598, American Society for Testing and Materials, pp. 131–143, 1976

For abstract, see DeMore, W. B.

FIELDS, N. D.

F08 Preparation of Pure Microbiological Samples for Pyrolysis Gas-Liquid Chromatography Studies

G. S. Oxborrow, N. D. Fields, and J. R. Puleo

Appl. Environ. Microbiol., Vol. 32, No. 2, pp. 306–309, August 1976

For abstract, see Oxborrow, G. S.

FINEGOLD, J. G.

F09 Hydrogen: Primary or Supplementary Fuel for Automotive Engines

J. G. Finegold

Paper 760609, SAE West Coast Meeting, San Francisco, Calif., Aug. 9–12, 1976

Hydrogen, gasoline, and mixtures thereof were compared as fuels for lean-burn engines. Hydrogen for the mixed fuels tests was generated by partial oxidation of gasoline. Hydrogen combustion yielded the highest thermal efficiency at any NO_x level. Gasoline yielded the second highest thermal efficiency for NO_x levels greater than or approximately equal to two gm/mi. For lower NO_x levels and high vehicle inertia weights, progressively more hydrogen supplementation was the second most efficient system. For vehicle inertia weights below 5000 lbm (2300 kg), the statutory NO_x standard (0.4 gm/mi) could be met with one lb/hr (0.13 g/s) hydrogen supplementation.

FINNEGAN, E. J.

F10 High-Power Transmitter High-Voltage Power Supply Ripple

E. J. Finnegan

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 84–87, February 15, 1976

This article reports the results of decreasing the high-voltage power supply ripple by redesigning the low-pass filter.

FLANAGAN, F. M.

F11 Tracking and Data Systems Support for the Helios Project: Project Development Through End of Mission Phase II

P. S. Goodwin, M. R. Traxler, W. G. Meeks, and F. M. Flanagan

Technical Memorandum 33-752, Vol. I, July 1, 1976

For abstract, see Goodwin, P. S.

FLIEGEL, H. F.

F12 A Demonstration of an Independent-Station Radio Interferometry System With 4-cm Precision on a 16-km Base Line

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, L. J. Skjerve, D. J. Spitzmesser, and H. F. Fliegel

J. Geophys. Res., Vol. 81, No. 5, pp. 995–1005, February 10, 1976

For abstract, see Thomas, J. B.

F13 A Demonstration of a Transportable Radio Interferometric Surveying System With 3-cm Accuracy on a 307-m Base Line

K. M. Ong, P. F. MacDoran, J. B. Thomas, H. F. Fliegel, L. J. Skjerve, D. J. Spitzmesser, P. D. Batelaan, S. R. Paine, and M. G. Newsted (Trend Western Engineering Corporation)

J. Geophys. Res., Vol. 81, No. 20, pp. 3587–3593, July 10, 1976

For abstract, see Ong, K. M.

FORTENBERRY, J. W.

F14 Five-Meter-Diameter Conical Furlable Antenna

J. W. Fortenberry, R. E. Freeland, and D. M. Moore

Technical Report 32-1604, July 15, 1976

The goals of the program reported here were two-fold: to demonstrate that a 5-meter-diameter, furlable, conical reflector antenna utilizing a line source feed can be fabricated utilizing composite materials and prove that the antenna can function mechanically and electrically as prototype flight hardware. The design, analysis, and testing of the antenna are described. An RF efficiency of 55% at 8.5 GHz and a surface error of 0.64 mm rms were chosen as basic design requirements. Actual test measurements yielded an efficiency of 53% (49.77-dB gain) and a surface error of 0.61 mm rms. Atmospherically induced corrosion of the reflector mesh resulted in the RF performance degradation. An assessment of the antenna as compared to the current state-of-the-art technology was made. This assessment included cost, surface accuracy and RF performance, structural and mechanical characteristics, and possible applications.

FOSTER, C. F.

F15 Telecommunications Division Fourth Harmonic Power Analyzer

C. F. Foster

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 39–42, August 15, 1976

This report describes the development of a microprocessor-based instrumentation system to be used in the measurement and analysis of fourth harmonic power generated by the DSN high-power transmitters.

FRANK, H. A.

F16 Life Capability of the Silver Electrode in Alkaline Electrochemical Cells

H. A. Frank

Technical Memorandum 33-789, August 1, 1976

The investigation described in this report was concerned with establishing the life capability of silver electrodes in alkaline cells. The results were employed in predicting the life capability of the proposed new Ag-H_2 cell and also in assessing the merits of employing silver electrodes in long-life probe batteries.

F17 Impedance of Silver Oxide-Zinc Cells

H. A. Frank, W. L. Long, and A. A. Uchiyama

J. Electrochem. Soc., Vol. 123, No. 1, pp. 1–9, January 1976

Over 100 sealed AgO-Zn cells were subjected to prolonged periods of storage over a range of temperatures and storage modes including open circuit, trickle charge, and float charge. Impedances of these cells were monitored throughout and to the end of the storage period at which point their transient voltage characteristics were observed at the onset of discharge. Results revealed that the impedances of these cells tended to increase with time on stand and that the magnitude of the impedance rise was dependent primarily on temperature and to a lesser degree on storage mode. Typical values for 50 A-hr cells were usually less than 100 mohm at time zero (immediately after activation) and from 1 to 30 ohm

after 6–10 months of storage. Transient voltages of these cells were noted to drop sharply during the first msec of discharge and then to rise and reach a stabilized value during the following few seconds. Magnitude of the initial drop as well as the stabilized voltage values was found to be related to impedance but not in a linear manner. Magnitude and duration of the low transient voltages may be unacceptable in some applications of these cells. Cause for the impedance variations is attributed to changes that occur at the positive electrode. Results provide new and useful information for designers and users of AgO-Zn-based power systems.

FREELAND, R. E.

F18 Five-Meter-Diameter Conical Furlable Antenna

J. W. Fortenberry, R. E. Freeland, and D. M. Moore

Technical Report 32-1604, July 15, 1976

For abstract, see Fortenberry, J. W.

FRIEDEN, H. J.

F19 Computer-Assisted Karyotyping

K. R. Castleman, J. Melnyk (City of Hope National Medical Center), H. J. Frieden, G. W. Persinger (City of Hope National Medical Center), and R. J. Wall

J. Reproductive Med., Vol. 17, No. 1, pp. 53–57, July 1976

For abstract, see Castleman, K. R.

FUTRELL, J. H.

F20 Ion Cyclotron Resonance Studies of Some Reactions of C^+ Ions

V. G. Anicich W. T. Huntress, Jr., and J. H. Futrell (University of Utah)

Chem. Phys. Lett., Vol. 40, No. 2, pp. 233–236, June 1, 1976

For abstract, see Anicich, V. G.

F21 Comments on "Reactions of Excited and Ground State H_3^+ Ions With Simple Hydrides and Hydrocarbons"

V. G. Anicich (University of Utah), J. H. Futrell (University of Utah), W. T. Huntress, Jr., and J. K. Kim

Int. J. Mass Spectrom. Ion Phys., Vol. 18, No. 1, pp. 63–64, September 1975

For abstract, see Anicich, V. G.

FYMAT, A. L.

F22 A New Approach to Radiative Transfer Theory Using Jones's Vectors

A. L. Fymat and R. Vasudevan (University of Southern California)

Astrophys. Space Sci., Vol. 38, No. 1, pp. 95–124, November 1975

Radiative transfer of partially polarized radiation in an anisotropically scattering, inhomogeneous atmosphere containing an arbitrary polydispersion of particles is described using Jones's amplitude vectors and matrices. This novel approach exploits the close analogy between the quantum mechanical states of spin 1/2 systems and the polarization states of electromagnetic radiation described by Jones's vector, and draws on the methodology of such spin 1/2 systems. The complete equivalence between the transport equation for Jones's vectors and the classical radiative transfer equation for Stokes's intensity vectors is demonstrated in two independent ways after deriving the transport equations for the polarization coherency matrices and for the quaternions corresponding to the Jones's vectors. A compact operator formulation of the theory is provided, and used to derive the necessary equations for both a local and a global description of the transport of Jones's vectors. Lastly, the integro-differential equations for the amplitude reflection and transmission matrices are derived, and related to the usual corresponding equations. The present formulation is the most succinct and the most convenient one for both theoretical and experimental studies. It yields a simpler analysis than the classical formulation since it reduces by a factor of two the dimensionality of transfer problems. It preserves information on phases, and thus can be used directly across the entire electromagnetic spectrum without any further conversion into intensities.

F23 Inverse Atmospheric Radiative Transfer Problems: A Nonlinear Minimization Search Method of Solution

A. L. Fymat

Phys. Earth Planet. Interiors, Vol. 12, No. 2/3, pp. 273–282, August 1976

The mathematical inversion of the equations of radiative transfer is an important tool for the remote sensing and probing of the atmosphere. These equations take the form of first-kind Fredholm integral equations (extinction and primary scattering of solar radiation, thermal emission from the atmosphere–surface system), ratios of such equations, and nonlinear integrodifferential equations

(multiple scattering). A nonlinear minimization search method for solving these various equations is presented and discussed relatively to uniqueness, stability and accuracy of the solution it yields. The method is a direct search in parameter space aimed at minimizing the objective function of the problem considered without resorting to a gradient approach. The proposed algorithm is basically a nonlinear least-squares minimization which relies on a random number generator to find an improved iterate at each step. It makes constant use of the measurements in order to arrive at the solution. It does not depend on the initial guess for well-behaved problems, and does not require any a priori information on the solution. It is quite general and can be applied to any inverse problem which can be reduced to the determination of a certain number, however large, of unknown parameters. The computation times involved tend to increase in proportion to the first power of the number of variables in opposition to most classical optimization methods where the proportion is to the cube of the number of variables. Illustrations are provided in the field of environmental particulate pollution where aerosol physical parameters are sought from measurements of solar extinction ratios.

GALLAGHER, J. F.

G01 Advanced Multilateration Theory, Software Development, and Data Processing: The MICRODOT System

P. R. Escobal, J. F. Gallagher (Computer Sciences Corp.), and O. H. von Roos

Technical Memorandum 33-792, July 4, 1976

For abstract, see Escobal, P. R.

GALVEZ, J. L.

G02 Viking Telecommunication Effects of GEOS Satellite Interference Based on Testing at the Madrid Deep Space Station

F. V. Stuhr, S. S. Kent, J. L. Galvez, B. G. Luaces, G. R. Pasero, and J. M. Urech

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 60–74, August 15, 1976

For abstract, see Stuhr, F. V.

GATZ, E. C.

G03 DSN Telemetry System Data Records

E. C. Gatz

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 4–7, June 15, 1976

The DSN Telemetry System now includes the capability to provide a complete magnetic tape record, within 24 hours of reception, of all telemetry data received from a spacecraft. This record, the Intermediate Data Record, is processed and generated almost entirely automatically, and provides a detailed accounting of any missing data.

GEORGEVIC, R. M.

G04 Solar Radiation Pressure Effects on the Helios Spacecraft

R. M. Georgevic

Technical Memorandum 33-778, July 15, 1976

The improved and completed mathematical model of the solar radiation force and torques, which has been previously developed for the Mariner 10 Venus/Mercury spacecraft mission, is used for a detailed analysis of the effects of the solar light pressure on the Helios spacecraft. Due to the fact that the main body of the Helios spacecraft is a surface of enclosure, inside of which most of the reradiated thermal energy is lost, expressions for the portion of the solar radiation force, produced by the thermal reradiation, had to be given a different form. Hence the need for the derivation of a somewhat different theoretical model for the force acting on the main body of the spacecraft.

G05 Disturbing Effects of Attitude Control Maneuvers on the Orbital Motion of the Helios Spacecraft

R. M. Georgevic

Technical Memorandum 33-785, September 15, 1976

The position of the spin axis of the Helios A spacecraft has been maintained and updated by a series of attitude control maneuvers, by means of a sequence of unbalanced jet forces which produce an additional disturbed motion of the spacecraft's center of mass. This report examines the character of this motion, its magnitude and direction. In addition to this, for practical purposes of the orbit determination of the spacecraft, a computer program shows how the components of the disturbing acceleration in the spacecraft-fixed reference frame can be easily computed. The program is given as an appendix to this report.

GIFFIN, C. E.

G06 The Role of Fiber Optics in Mass Spectrometer Electro-Optical Ion Detection

D. D. Norris and C. E. Giffin

Proc. SPIE Conf. Fibers & Integrated Opt., Reston, Va., Mar. 22–23, 1976, Vol. 77, pp. 103–108

For abstract, see Norris, D. D.

GIGAS, G.

G07 Correlation of Displacement Effects Produced by Electrons, Protons, and Neutrons in Silicon

V. A. J. van Lint, G. Gigas, and J. B. Barengoltz

IEEE Trans. Nucl. Sci., Vol. NS-22, No. 6, pp. 2663–2668, December 1975

For abstract, see van Lint, V. A. J.

GILLESPIE, A. R.

G08 Thermal Inertia Imaging: A New Geologic Mapping Tool

A. B. Kahlé, A. R. Gillespie, and A. F. H. Goetz

Geophys. Res. Lett., Vol. 3, No. 1, pp. 26–28, January 1976

For abstract, see Kahle, A. B.

G09 Thermal Inertia Mapping

A. B. Kahle, A. R. Gillespie, A. F. H. Goetz, and J. D. Addington

Proc. Tenth Int. Symp. Remote Sensing of Environ., Univ. of Michigan, Ann Arbor, Mich., Oct. 6–10, 1975, pp. 985–994

For abstract, see Kahle, A. B.

GIRDNER, D.

G10 DSS 14 Operating Noise Temperature During Helios 1 Near-Sun Tracking

C. T. Stelzried and D. Girdner

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 68–76, June 15, 1976

For abstract, see Stelzried, C. T.

GLENN, M. S.

G11 DSN Ground Communications Facility

M. S. Glenn

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 4–12, December 15, 1976

The Ground Communications Facility has been designed to provide reliable Earth-based, point-to-point voice and data communications as part of the DSN Tracking and Data Acquisition System.

GLUCKLICH, J.

G12 The Tearing Test as a Means for Estimating the Ultimate Properties of Rubber

J. Glucklich and R. F. Landel

J. Appl. Polym. Sci., Vol. 20, No. 1, pp. 121–137, January 1976

SBR, unfilled and filled with glass beads, MT, and HAF carbon blacks, was tested for tearing energy, rupture values in simple tension, tear diameter, and strain distribution at four rates and seven temperatures. The energy density to failure at the tear zone W_t was obtained from the tearing energy τ and the natural tear diameter d using a modified Rivlin and Thomas relationship $W_t \approx \tau/d$. This was then compared with the nominal energy density at rupture in simple tension W. It is shown that always $W_t > W$ (sometimes $W_t/W = 10$), that W_t is subject to a smaller statistical scatter than W, and that W_t is more amenable to the WLF type of superposition than W. It is concluded that W_t and not W is the strength-determining property. Where W data permitted superposition, it followed the WLF equation. It is presumed that so would W_t. τ, although more superposable than W, showed a bigger shift factor than that dictated by WLF, the difference being the result of the temperature dependence of the diameter. The reinforcing effects of the various fillers are also discussed. It is shown that the carbon black fillers increase both W_t and d. Glass beads have only a small effect on d and none on W_t.

GOETZ, A. F. H.

G13 Digital Image Enhancement Techniques Used in Some ERTS Application Problems

A. F. H. Goetz and F. C. Billingsley

Contrib. Geol., Vol. 12, No. 2, pp. 7–21, 1974

Enhancement and classification are not competing methods for machine image analysis. In fact enhanced images can be used alone or as inputs to classification routines. However, in some problems the spatial relationships are equal in importance to the classification results and enhancements can be designed to provide both types of information in one image. Enhancements discussed include contrast stretching, multiratio color displays, Fourier plane operations to remove striping and boosting

MTF response to enhance high spatial frequency content. The use of each technique in a specific application in the fields of geology, geomorphology, and oceanography is demonstrated.

G14 Discrimination of Rock Types and Detection of Hydrothermally Altered Areas in South-Central Nevada by the Use of Computer-Enhanced ERTS Images

L. C. Rowan (U.S. Geological Survey),
P. H. Wetlaufer (U.S. Geological Survey),
A. F. H. Goetz, F. C. Billingsley, and
J. H. Stewart (U.S. Geological Survey)

Geological Survey Professional Paper 883, U. S. Government Printing Office, Washington, 1976

For abstract, see Rowan, L. C.

G15 Thermal Inertia Imaging: A New Geologic Mapping Tool

A. B. Kahle, A. R. Gillespie, and A. F. H. Goetz

Geophys. Res. Lett., Vol. 3, No. 1, pp. 26–28, January 1976

For abstract, see Kahle, A. B.

G16 Thermal Inertia Mapping

A. B. Kahle, A. R. Gillespie, A. F. H. Goetz, and J. D. Addington

Proc. Tenth Int. Symp. Remote Sensing of Environ., Univ. of Michigan, Ann Arbor, Mich., Oct. 6–10, 1975, pp. 985–994

For abstract, see Kahle, A. B.

GOLDSTEIN, B. E.

G17 Energetic Particles of the Outer Regions of Planetary Magnetospheres

B. T. Tsurutani, B. E. Goldstein, and A. Bratenahl

Technical Memorandum 33-766, March 1, 1976

For abstract, see Tsurutani, B. T.

G18 Magnetic Permeability Measurements and a Lunar Core

B. E. Goldstein, R. J. Phillips, and
C. T. Russell (University of California, Los Angeles)

Geophys. Res. Lett., Vol. 3, No. 6, pp. 289–292, June 1976

Measurements of the magnetic field induced in the moon while it is in the geomagnetic tail lobes have been interpreted in terms of lunar magnetic permeability due to free iron content; such studies ignored the possibility that a highly conducting lunar core (Fe or FeS) would exclude magnetic fields with an apparent diamagnetic effect. Using lunar chemical and thermal models to determine plausible limits of magnetic permeability, we interpret measurements of the induced moment. The maximum-likely radius of a lunar core is 580 km. Subsatellite and ALSEP measurements of the induced field are in disagreement. Resolving the differences is critical to determining whether a core could or does exist.

G19 On the Apparent Diamagnetism of the Lunar Environment in the Geomagnetic Tail Lobes

B. E. Goldstein and C. T. Russell (University of California, Los Angeles)

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 2999–3012, 1975

Apollo 15 and 16 subsatellite measurements of the lunar magnetic fields have revealed an effective dipole moment opposing the external geomagnetic field. This phenomenon, which is important for estimates of lunar magnetic permeability, is investigated by comparing simple models with the observed field profiles. Plasma diamagnetism requires an increased plasma energy density in the lunar vicinity; thus all plasma interactions in which the moon acts as an absorbing surface create effects opposite in sign to those observed. One source of increased plasma density might be the photoionization of lunar atmospheric neutrals. However, photoelectron interchange with the lunar surface would lead to heating of such an ionosphere causing it to expand away from the lunar vicinity with speeds of 5–20 km/s. A more attractive alternative is that a positive lunar potential and/or local remanent magnetic field acts to reflect a substantial portion of low-energy ions incident upon the moon from external sources. The low-energy particle events (LEPs) observed with the SIDE instrument would result in a net positive induced moment if solely absorbed by the moon, but due to the conversion of bulk speed to thermal energy-reflected particles might cause a negative moment even with only 5–10% reflection. The observed field profiles do not correspond well to either a hemispherical shell ionospheric model due to photoionization of lunar atmosphere neutrals or to a half-cylindrical "ionosphere" due to LEPs Rather they correspond best to a day–night symmetric current system. Time-dependent eddy currents in the lunar interior might explain the magnetic observations; a possible way of obtaining nonzero average contributions from TE mode waves is discussed.

GOLDSTEIN, R. M.

G20 Radar Observations at 3.5 and 12.6 cm Wavelength of Asteroid 433 Eros

R. F. Jurgens and R. M. Goldstein

Icarus, Vol. 28, No. 1, pp. 1–15, May 1976

For abstract, see Jurgens, R. F.

G21 Venus Radar Images

R. M. Goldstein, R. R. Green, and H. Rumsey, Jr.

J. Geophys. Res., Vol. 81, No. 26, pp. 4807–4817, September 10, 1976

Seven new radar images of portions of Venus are presented, along with corresponding altitude contours. Each is of a circular region of 1500-km diameter located near the Venusian equator. Areal resolution is, typically, 10 × 10 km; altitude resolution is 500 m. Much structure of geologic interest is revealed.

GOODWIN, P. S.

G22 Helios Mission Support

P. S. Goodwin, W. G. Meeks, R. E. Morris, and S. E. Reed

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 15–20, February 15, 1976

Having observed its first year anniversary in orbit about the Sun, the Helios-1 spacecraft has performed satisfactorily. During its first year, valuable scientific data were obtained about the Sun and our solar system. As Helios 1 enters its second year of successful operation, preparations for the launch of Helios B are in their final stage.

G23 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 31–37, April 15, 1976

The second Helios spacecraft was successfully launched on January 15, 1976. The trajectory will allow inspection of the solar atmosphere at an unprecedented 0.29 astronomical units (AU) distance from the Sun during the Helios-2 perihelion in April 1976. Such a close solar approach will greatly enhance man's knowledge of the inner part of our solar system. This article reports on the prelaunch and launch activities through the first six days of the Helios-2 mission, as well as the cruise status of the Helios-1 spacecraft.

G24 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 26–31, June 15, 1976

With Helios-1 completing its third perihelion and Helios-2 passing its first perihelion, much valuable scientific data were obtained about the inter-Earth-Sun regions. The first solar occultation of Helios-2 is anxiously awaited as the next important mission phase. Preparations are underway for Helios-2 first entry into solar occultation in mid-May 1976. This article reports on the activities around Helios-1 and -2 perihelions.

G25 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 21–26, August 15, 1976

The successful flight of the Helios-1 spacecraft continues as it approaches its third aphelion. The Helios-2 spacecraft has entered its first superior conjunction and continues in excellent health. Much valuable scientific information about the solar corona and its effects on electromagnetic waves is expected to be learned from data gathered during this superior conjunction.

G26 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 24–27, October 15, 1976

Data from both Helios-1 and Helios-2 spacecraft in solar orbits continue to expand man's knowledge of our solar system. Having completed their third and first aphelions, respectively, the trajectories of both spacecraft will bring about perihelions in October 1976. Helios 2, while still in its five-month (May–September) superior conjunction, continues to supply valuable data for experiments 11 and 12 (Celestial Mechanics and Faraday Rotation). Helios 1 remains in cruise phase.

G27 Helios Mission Support

P. S. Goodwin, E. S. Burke, and R. E. Morris

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 28–34, December 15, 1976

Operating beyond its 18-month design lifetime, the Helios-1 spacecraft continues to gather valuable scientific data. Having achieved its fourth perihelion, the Helios-1 spacecraft is being closely followed by Helios-2, as the latter emerges from a lengthy solar conjunction period,

in which considerable scientific data were collected on Experiments 11 and 12 (Celestial Mechanics and Faraday Rotation). The scientific opportunities to compare the data from the two Helios spacecraft continue to add to man's knowledge of the sun's influence upon the inner solar system.

G28 Tracking and Data Systems Support for the Helios Project: Project Development Through End of Mission Phase II

P. S. Goodwin, M. R. Traxler, W. G. Meeks, and F. M. Flanagan

Technical Memorandum 33-752, Vol. I, July 1, 1976

This report summarizes the overall evolution of the Helios Project from its conception in September 1966 through completion of the Helios-1 Mission Phase II on April 13, 1975. Beginning with the Project objectives and concluding with the Helios-1 spacecraft entering its first superior conjunction (end of Mission Phase II), the narrative includes descriptions of the Project, the mission and its phases, international management and interfaces, and DSN-Spacecraft engineering development in telemetry, tracking, and command systems to ensure compatibility between the U.S. Deep Space Network and the German-built spacecraft.

GORDON, I. L.

G29 Functional Polymeric Microspheres Based on 2-Hydroxyethyl Methacrylate for Immunochemical Studies

A. Rembaum, S. P. S. Yen, E. Cheong, S. Wallace, R. S. Molday (California Institute of Technology), I. L. Gordon (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

Macromolecules, Vol. 9, No. 2, pp. 328–336, March–April 1976

For abstract, see Rembaum, A.

GOSS, W. C.

G30 A Microprocessor-Controlled CCD Star Tracker

P. M. Salomon and W. C. Goss

Preprint 76-116, AIAA Fourteenth Aerospace Sciences Meeting, Washington, D. C., January 26–28, 1976

For abstract, see Salomon, P. M.

GRAHAM, R. A.

G31 Inherent Time Delay for Dielectric Breakdown in Shock-Loaded x-Cut Quartz

R. A. Graham (Sandia Laboratories) and L. C. Yang

J. Appl. Phys., Vol. 46, No. 12, pp. 5300–5301, December 1975

Dielectric breakdown in shock-loaded x-cut quartz is examined under conditions of both impact loading and Q-switched laser-irradiation loading. It is observed that breakdown is characterized by an inherent time delay which depends on the magnitude of the electric field. For pulse duration less than about 30 ns, dielectric breakdown is not observed.

GREEN, R. R.

G32 A Radar Study of the Backup Martian Landing Sites

G. S. Downs, R. R. Green, and P. E. Reichley

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 49–52, December 15, 1976

For abstract, see Downs, G. S.

G33 Radar Measurements of Martian Topography and Surface Properties: The 1971 and 1973 Oppositions

G. S. Downs, P. E. Reichley, and R. R. Green

Icarus, Vol. 26, No. 3, pp. 273–312, November 1975

For abstract, see Downs, G. S.

G34 Venus Radar Images

R. M. Goldstein, R. R. Green, and H. Rumsey, Jr.

J. Geophys. Res., Vol. 81, No. 26, pp. 4807–4817, September 10, 1976

For abstract, see Goldstein, R. M.

GREENHALL, C. A.

G35 DSN Telemetry System Performance With Convolutionally Coded Data: Sequential Decoding Update

C. A. Greenhall

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 123–130, June 15, 1976

DSN Telemetry System performance in decoding convolutionally coded data by both sequential and maximum-

likelihood techniques is being determined by testing at various Deep Space Stations. This article describes corrections and refinements to the sequential decoding tests.

G36 DSN Performance Tests of a Maximum Likelihood Decoder

J. M. Urech, L. D. Vit, and C. A. Greenhall

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 131–146, June 15, 1976

For abstract, see Urech, J. M.

GRETH, H. A.

G37 Modification of Moore Measuring Machine/Leitz Microscope

H. A. Greth and L. Brubaker

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 147–148, June 15, 1976

Quality Assurance Mechanical Inspection, anticipating the need for improved measuring techniques for the various Laboratory programs, has perfected a modification of the Leitz Microscope for the Moore Measuring Machine that has the capability of significantly reducing inspection time with increased reliability.

GULKIS, S.

G38 The Problem of Spiral Galaxies and Satellite Radio Sources

H. Arp (Hale Observatories), R. Carpenter, S. Gulkis, and M. Klein

Astrophys. J., Vol. 205, No. 3, pp. 721–727, May 1, 1976

For abstract, see Arp, H.

GUPTA, A.

G39 The Electrical and Magnetic Properties of $(TTF)(I)_{0.71}$

R. B. Somoano, A. Gupta, V. Hadek, T. Datta (Tulane University), M. Jones (Tulane University), R. Deck (Tulane University), and A. M. Hermann (Tulane University)

J. Chem. Phys., Vol. 63, No. 11, pp. 4970–4976, December 1, 1975

For abstract, see Somoano, R. B.

HADEK, V.

H01 The Electrical and Magnetic Properties of $(TTF)(I)_{0.71}$

R. B. Somoano, A. Gupta, V. Hadek, T. Datta (Tulane University), M. Jones (Tulane University), R. Deck (Tulane University), and A. M. Hermann (Tulane University)

J. Chem. Phys., Vol. 63, No. 11, pp. 4970–4976, December 1, 1975

For abstract, see Somoano, R. B.

HAGAR, H., JR.

H02 Approximate Statistics of Random Vector Magnitudes

H. Hagar, Jr.

AIAA J., Vol. 14, No. 5, pp. 700–702, May 1976

This paper presents simple, rough approximations for the mean and 99% values for random vectors of up to three independent elements.

HAINES, E. L.

H03 Chemical Mapping of Planetary Surfaces

E. L. Haines, J. R. Arnold (University of California, San Diego), and A. E. Metzger

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 141–153, July 1976

Two instruments, the gamma-ray spectrometer and the X-ray fluorescence spectrometer, are uniquely suited to the chemical mapping of planetary surfaces from orbit. Through their detection of characteristic line spectra, they measure the concentrations of a suite of elements in each area overflown. Multielement chemical maps derived from these remote measurements are used in the construction of evolutionary models of planetary bodies and of the solar system as a whole. The NaI(Tl) gamma-ray spectrometer and a gas proportional X-ray spectrometer were flown over 20 percent of the lunar surface during Apollo 15 and 16 missions. These instruments measured chemical differences across the boundaries of known lunar provinces and revealed several new features of lunar-surface composition. Advanced spectrometers, which are under development for future missions, are able to educe much more information in a given time span than the Apollo instruments. They may be used in possible future missions such as Lunar Polar Orbiter, a Mars orbiter, a Mercury orbiter, outer planet satellite missions, rendezvous with asteroids and cometary nuclei, and surface-penetrating probes.

H04 Thorium–Uranium Fission Radiography

E. L. Haines, J. R. Weiss,
D. S. Burnett (California Institute of Technology), and D. S. Woolum (California Institute of Technology)

Nucl. Instrum. Methods, Vol. 135, No. 1, pp. 125–131, May 15, 1976

The high energy secondary neutron flux, produced by stopping the 650 MeV proton beam of the Los Alamos Meson Physics Facility (LAMPF), has been tested for use in measurements of the microscale distribution of Th in heterogeneous samples, particularly rocks. Polished samples are covered with mica which serves as a detector for neutron-induced fission tracks. The sample is also irradiated in a nuclear reactor in order to measure the U distribution and to determine the correction required for U fission in the high energy exposure. The relative Th/U fission rates range from 0.14 to 0.31, depending on the amount of internal neutron moderation within the samples. The relative $^{232}Th/^{238}U$ fission rate, as calculated from the theoretical beam stop spectrum is somewhat higher (0.5), probably reflecting a contribution from low energy ^{235}U fission in the observed ratio. The measured relative $^{209}Bi/^{232}Th$ fission rates are higher by a factor of 2–7 than those calculated from the theoretical neutron spectrum indicating that the flux of high energy (200 MeV) neutrons has been underestimated in the theoretical spectrum. Th fission track production rates of (0.5–2) $\times$ $10^4/cm^2 \cdot mA \cdot h \cdot ppm$ Th were measured, with the lower values being more in accord with those calculated from the theoretical spectrum. The technique is limited by background from recoil tracks in the mica. The relative rate of fission to recoil is $\sim 3 \times 10^{-6}$ fission/recoil·ppm Th. However, by differential annealing of the recoil tracks, we are able to count fission tracks in the presence of a large background of recoil tracks. In order to measure the Th concentration in individual gains to ±10% in 10 h exposures, the product of the Th concentration in ppm and the area of the grain in cm^2 is $\sim 2 \times 10^{-3}$, i.e., for 1 ppm Th roughly 400 μm grains are required.

H05 The Fission Track Record of Apennine Front KREEP Basalts

E. L. Haines, I. D. Hutcheon (University of California, Berkeley), and J. R. Weiss

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 3527–3540, 1975

Whitlockite grains in two Apennine Front KREEP soil fragments contain extremely high densities of fission tracks. A new method is described in which particle tracks are examined in an actinide-poor phase bordering an actinide-rich whitlockite phase. This method clearly distinguishes the fission track contributions from other track sources; e.g., Fe-group cosmic rays, spallation recoils, and dislocations. Observed track excesses, when corrected for U- and Th-related fission sources, are 4–20 times greater than the contribution from spontaneous fission of ^{238}U (based on an age of 4 G.y.), and probably represent a large and variable contribution from the fission of ^{244}Pu. These fragments may have pre-Imbrium ages, underscoring the importance of KREEP as a constituent of the pre-mare lunar crust. Track excesses are not correlated with the U or Th contents of the whitlockite grains. This behavior suggests that Pu fractionates differently from U and Th in lunar igneous KREEP.

HALL, D. K.

H06 A Comparative Study of Active and Passive Microwave Imagery Over the North Slope of Alaska

M. L. Bryan (California Institute of Technology) and D. K. Hall (NASA)

Proc. Ass. Amer. Geogr. Meeting, New York, N. Y., Apr. 11–14, 1976, pp. 164–168

For abstract, see Bryan, M. L.

HAMILTON, C. L.

H07 An Experiment in Dynamic Modeling for a Complete Solar-Powered Energy System

C. L. Hamilton

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 137–143, February 15, 1976

Completion of a prototype dynamic model simulating the performance of a solar-powered energy system is described. A set of hypothetical components is specified, and the outcome of test analyses of the resulting system is outlined. On the basis of this exercise, it appears that the dynamic modeling technique will constitute a useful and convenient tool for analyzing performance of time-dependent system.

H08 Dynamic Modeling for Evaluation of Solar Collector Performance

C. L. Hamilton

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 141–146, August 15, 1976

A dynamic model program designed to aid in the understanding of solar collector behavior over the full range of operating conditions has been constructed and tested in the evaluation of a conceptual collector design.

H09 **Toward a Mathematical Model of Solar Radiation for Engineering Analysis of Solar Energy Systems**

C. L. Hamilton and M. S. Reid

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 147–151, August 15, 1976

This report presents some first thoughts on mathematical models of solar radiation suitable for use in engineering analysis of solar energy systems. Included is a discussion of the currently most-used insolation model and what improvements might be made in it to better suit it for use in designing energy systems. An approach to constructing an upgraded model is sketched.

HAMMING, W. J.

H10 **Interagency Comparison of Iodometric Methods for Ozone Determination**

W. B. DeMore, J. C. Romanovsky (Environmental Protection Agency), M. Feldstein (Bay Area Air Pollution Control District, San Francisco), W. J. Hamming (Los Angeles County Air Pollution Control District), and P. K. Mueller (Environmental Research and Technology, Inc.)

Calibration in Air Monitoring, ASTM STP 598, American Society for Testing and Materials, pp. 131–143, 1976

For abstract, see DeMore, W. B.

HARDMAN, J. M.

H11 **Inflight Calibration Technique for Onboard High-Gain Antenna Pointing**

H. Ohtakay and J. M. Hardman (Boeing Aerospace Company)

J. Spacecraft Rockets, Vol. 12, No. 12, pp. 754–759, December 1975

For abstract, see Ohtakay, H.

HARRIS, A. W.

H12 **ALSEP–Quasar Differential VLBI**

M. A. Slade, R. A. Preston, A. W. Harris, L. J. Skjerve, and D. J. Spitzmesser

The Deep Space Network. March and April 1976, DSN Progress Report 42-33, pp. 37–54, June 15, 1976

For abstract, see Slade, M. A.

H13 **2290-MHz Flux Densities of 52 High-Declination Radio Sources**

A. W. Harris, R. A. Preston, D. J. Spitzmesser, M. A. Slade, and L. J. Skjerve

Astron. J., Vol. 81, No. 4, pp. 222–224, April 1976

The Deep Space Network 64-m antenna at Goldstone was used to obtain total flux-density measurements at 2290 MHz of sources from low-frequency catalogs (principally 4C and 4CP) in a search for potential compact VLBI sources at high declination. Subsequent VLBI observations between Goldstone and Madrid of six candidates identified here have resulted in the discovery of two new high-declination VLBI sources: 4CP 71.07 and OQ 663.

HARRISON, E. C.

H14 **In Vivo Degradation of Silicone Rubber Poppets in Prosthetic Heart Valves**

E. F. Cuddihy, J. Moacanin, E. J. Roschke, and E. C. Harrison (University of Southern California)

J. Biomed. Mater. Res., Vol. 10, No. 3, pp. 471–481, May 1976

For abstract, see Cuddihy, E. F.

HARTMAN, R. E.

H15 **A System for the Direct Digitization of Electron Images From a TEM**

R. E. Hartman, H. Alsberg, R. S. Hartman, R. Nathan, and P. Wendell

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. I, pp. 96–97

A silicon diode vidicon is described that is used for direct sensing of electron images on a transmission electron microscope.

H16 **The Improved Stability of an Organic Crystal in the Hitachi HV-1 High Vacuum Electron Microscope**

R. S. Hartman, R. E. Hartman, H. Alsberg, and R. Nathan

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. II, pp. 674–675

For abstract, see Hartman, R. S.

HARTMAN, R. S.

H17 A System for the Direct Digitization of Electron Images From a TEM

R. E. Hartman, H. Alsberg, R. S. Hartman, R. Nathan, and P. Wendell

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. I, pp. 96–97

For abstract, see Hartman, R. E.

H18 The Improved Stability of an Organic Crystal in the Hitachi HV-1 High Vacuum Electron Microscope

R. S. Hartman, R. E. Hartman, H. Alsberg, and R. Nathan

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. II, pp. 674–675

It is demonstrated that it is possible to find conditions in a transmission EM where stability far exceeds that predicted by current theories of "radiation damage" or that demonstrated by conventional electron microscopes—the first step in the development of methods for the control of "radiation damage" in biological specimens.

HATCH, J. T.

H19 Use of "Load and Go" Countdowns by the DSN Deep Space Stations

J. T. Hatch

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 124–128, August 15, 1976

The Level-4 Prepass Readiness Test (PRT) (the "load and go" countdown) provides an effective and low risk method of improving Network productivity. A carefully controlled trial period preceded the full-scale application of the Level-4 PRT to Pioneer, Helios and Viking cruise tracking operations. Use of this "load and go" concept to count down a station brings about a substantial increase in the proportion of total station hours devoted to spacecraft tracking.

HELTON, M. R.

H20 Landsat Follow-On: A Report by the Applications Survey Groups: Vol. I. Executive Summary

F. C. Billingsley, M. R. Helton, and V. M. O'Brien

Technical Memorandum 33-803, Vol. I, December 15, 1976

For abstract, see Billingsley, F. C.

H21 Landsat Follow-On: A Report by the Applications Survey Groups: Vol. II. Discipline Discussions

F. C. Billingsley, M. R. Helton, and V. M. O'Brien

Technical Memorandum 33-803, Vol. II, December 15, 1976

For abstract, see Billingsley, F. C.

HERMANN, A. M.

H22 The Electrical and Magnetic Properties of $(TTF)(I)_{0.71}$

R. B. Somoano, A. Gupta, V. Hadek, T. Datta (Tulane University), M. Jones (Tulane University), R. Deck (Tulane University), and A. M. Hermann (Tulane University)

J. Chem. Phys., Vol. 63, No. 11, pp. 4970–4976, December 1, 1975

For abstract, see Somoano, R. B.

HERRING, C. M.

H23 Method for Collecting Naturally Occurring Airborne Bacterial Spores for Determining Their Thermal Resistance

J. R. Puleo, M. S. Favero, G. S. Oxborrow, and C. M. Herring

Appl. Microbiol., Vol. 30, No. 5, pp. 786–790, November 1975

For abstract, see Puleo, J. R.

HIGA, W. H.

H24 Design of a Superconducting Cavity Stabilized Maser Oscillator

W. H. Higa

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 50–53, February 15, 1976

The pioneering works of W. H. Hartwig, S. R. Stein and J. Turneaure, J. J. Jimenez and A. Septier, and others have shown the possibility of using a superconducting cavity to stabilize a microwave oscillator. The achievement of cavity Qs of the order of 10^{10} has made possible the realization of frequency standards with performance which could surpass that of the hydrogen maser. The present study explores the possibility of integrating a superconducting cavity with a traveling wave maser to obtain a frequency standard with very high spectral purity.

H25 The Superconducting Cavity-Stabilized Maser Oscillator

W. H. Higa

Technical Memorandum 33-805, December 15, 1976

The pioneering works of W. H. Hartwig; S. R. Stein and J. Turneaure; J. J. Jimenez and A. Septier; and others have shown the possibility of using a superconducting cavity to stabilize a microwave oscillator. The achievement of cavity Qs of the order of 10^{10} has made possible the realization of frequency standards with performance which could surpass that of the hydrogen maser. The present study explores the possibility of integrating a superconducting cavity with a traveling wave maser to obtain a frequency standard with very high spectral purity.

HILBERT, E. E.

H26 Joint Pattern Recognition/Data Compression Concept for ERTS Multispectral Imaging

E. E. Hilbert

Proc. SPIE Seminar on Efficient Transmission of Pictorial Information, San Diego, Calif., Aug. 21–22, 1975, Vol. 66, pp. 122–137

This paper describes a new technique which jointly applies clustering and source encoding concepts to obtain data compression. The cluster compression technique basically uses clustering to extract features from the measurement data set which are used to describe characteristics of the entire data set. In addition, the features may be used to approximate each individual measurement vector by forming a sequence of scalar numbers which define each measurement vector in terms of the cluster features. This sequence, called the feature map, is then efficiently represented by using source encoding concepts. A description of a practical cluster compression algorithm is given, and experimental results are presented to show trade-offs and characteristics of various implementations. Examples are provided which demonstrate the application of cluster compression to multispectral image data of the Earth Resources Technology Satellite.

HOLLAND, J. C.

H27 An Error-Minimizing Software Audit Technique

J. C. Holland and W. O. Paine

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 201–221, April 15, 1976

This article presents a method for systematizing a software code-design audit, using principles of set theory to delineate, with a minimum of effort and a maximum of error-detecting capability, the various individual discrepancies present in the software.

HOLRITZ, C. A.

H28 Network Loading Visibility for Management

D. M. Enari and C. A. Holritz

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 128–131, February 15, 1976

For abstract, see Enari, D. M.

HOOKE, A. J.

H29 In-Flight Utilization of the Mariner 10 Spacecraft Computer

A. J. Hooke

J. Brit. Interplanet. Soc., Vol. 29, No. 4, pp. 273–285, April 1976

The Mariner 10 mission to Venus and Mercury represented a new mode of low-budget planetary exploration. The spacecraft was constrained to use a large number of existing, flight-proven subsystems: amongst these was a small digital control computer, based on a design previously flown on the Mariner 9 mission to Mars. This paper describes how the sequencing requirements of a highly ambitious science profile were accommodated within a machine having a memory capacity of only 512 words.

HORD, C. W.

H30 Complex Refractive Index of Martian Dust: Mariner 9 Ultraviolet Observations

K. D. Pang, J. M. Ajello, C. W. Hord (University of Colorado), and W. G. Egan (Grumman Aerospace Corporation)

Icarus, Vol. 27, No. 1, pp. 55–67, January 1976

For abstract, see Pang, K. D.

H31 Mariner 9 Ultraviolet Spectrometer Experiment: Bright-Limb Observations of the Lower Atmosphere of Mars

J. M. Ajello, K. D. Pang, A. L. Lane, C. W. Hord (University of Colorado), and K. E. Simmons (University of Colorado)

J. Atmos. Sci., Vol. 33, No. 3, pp. 544–552, March 1976

For abstract, see Ajello, J. M.

HOWE, T. W.

H32 Viking Mission Support

D. W. Johnston and T. W. Howe

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 13–21, December 15, 1976

For abstract, see Johnston, D. W.

HSIEH, T.

H33 System Design for a Nuclear Electric Spacecraft Utilizing Out-of-Core Thermionic Conversion

W. C. Estabrook, W. M. Phillips, and T. Hsieh

Technical Memorandum 33-791, September 1, 1976

For abstract, see Estabrook, W. C.

HUBBARD, W. B.

H34 Temperature of the Atmosphere of Jupiter From Pioneer 10/11 Radio Occultations

A. J. Kliore, P. M. Woiceshyn, and W. B. Hubbard (University of Arizona)

Geophys. Res. Lett., Vol. 3, No. 3, pp. 113–116, March 1976

For abstract, see Kliore, A. J.

HUME, J. P.

H35 Computerizing Goldstone Facility Maintenance Data for Management Decisions

F. R. Maiocco and J. P. Hume

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 310–330, April 15, 1976

For abstract, see Maiocco, F. R.

HUNG, N. T.

H36 Magnitude of 64-m Elevation Axis Movements Due to Alidade Temperature Changes

N. T. Hung, H. P. Phillips, and R. A. Zanteson

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 41–44, December 15, 1976

In projected very-long baseline interferometry (VLBI) work a reference point for 64-m antennas is the intersection of the elevation and azimuth axes. This report describes a minimum-level effort at DSS 14 to determine the magnitude of the effect of diurnal changes in the temperature of the alidade legs on the height of the elevation axis. The thermal expansion between the lowest recorded temperature –3°C (27°F) and the highest, 36°C (97°F), over the period covered was 8.9 mm (0.35 in.).

HUNTRESS, W. T., JR.

H37 Laboratory Studies of Ion-Neutral Reactions in Interstellar Regions: Gas-Phase Equilibrium Between HCN and NH_3 in Dense Clouds

W. T. Huntress, Jr. and V. G. Anicich

Astrophys. J., Vol. 208, No. 1, pp. 237–244, August 15, 1976

Laboratory studies have been conducted of ion-molecule reactions involved in the synthesis of NH_3, H_2O, and HCN in dense interstellar clouds, and the rate constants and product distributions for these reactions have been determined. The rate constant for the reaction $NH_3^+ + H_2 \rightarrow NH_4^+ + H$ is extremely slow at interstellar cloud temperatures, and this has some important consequences for mechanisms of NH_3 synthesis in these regions. Atomic C^+ ions formed in dense clouds by the reaction $He^+ + CO$ subsequently react with ammonia to produce the H_2CN^+ ion, leading to the synthesis of HCN. The HCN is subsequently destroyed in turn by reaction with C^+. In the case where HCN is both synthesized and destroyed by reaction of C^+ ions, a simple, model-independent expression can be obtained for the relative abundances of HCN and NH_3. When we use our laboratory results for the rate constants and product distributions of the appropriate reactions, the ratio $[HCN]/[NH_3] \approx 0.4$ is predicted. This result is consistent with the observations. Thermoneutral exchange between H_2CN^+ ions and HD is shown to be very slow, but the high [DCN]/[HCN] ratio observed in interstellar clouds can be explained by enhancement in the $[H_2D^+]/[H_3^+]$ ion ratio. On this basis, a large deuterium enhancement is also predicted for the "X-ogen" lines, $[DCO^+]/[HCO^+] \approx 10^{-3}$ to 10^{-2}.

H38 **Ion Cyclotron Resonance Studies of Some Reactions of C^+ Ions**

V. G. Anicich W. T. Huntress, Jr., and J. H. Futrell (University of Utah)

Chem. Phys. Lett., Vol. 40, No. 2, pp. 233–236, June 1, 1976

For abstract, see Anicich, V. G.

H39 **On the Reaction of N^+ Ions with O_2**

W. T. Huntress, Jr. and V. G. Anicich

Geophys. Res. Lett., Vol. 3, No. 6, pp. 317–318, June 1976

The product distribution for the reaction of thermal energy N^+ ions with O_2 has been measured by ion cyclotron resonance methods. Three product channels are identified with the following fractional distribution: $O_2^+ + N$, 0.65 ± 0.04; $NO^+ + O$, 0.31 ± 0.04; $O^+ + NO$, 0.04 ± 0.02.

H40 **Comments on "Reactions of Excited and Ground State H_3^+ Ions With Simple Hydrides and Hydrocarbons"**

V. G. Anicich (University of Utah), J. H. Futrell (University of Utah), W. T. Huntress, Jr., and J. K. Kim

Int. J. Mass Spectrom. Ion Phys., Vol. 18, No. 1, pp. 63–64, September 1975

For abstract, see Anicich, V. G.

H41 **The Chemistry of Planetary Atmospheres**

W. T. Huntress, Jr.

J. Chem. Educ., Vol. 53, No. 4, pp. 204–208, April 1976

The atmosphere of the earth is one of the major components which makes life possible on our home celestial body. We are intimately familiar with our own atmosphere, and in the previous two centuries have determined its bulk chemical composition. Only recently have we become aware of how important also are the trace components present in the atmosphere and how delicate is the balance between the earth's atmosphere, its oceans, and its biological and technological activity. Besides the earth's atmosphere, astronomers and scientists have always been curious about the atmospheres which exist on the other planets of the solar system and whether, for example, these alien atmospheres could support our own or other forms of life. With the dawn of the space age has come a new awareness of planetary science, and scientific vehicles have become available for the close-up examination of these new unexplored worlds. In the last two decades, a great deal has been learned about the origin and evolution of the planets and their atmospheres, using data obtained from both ground-based and spacecraft observations. In order to describe the chemistry of planetary atmospheres, we therefore begin with an outline of our present knowledge and the theories which attempt to explain these data. The theories presented here in a favorable light are not unique, and it is strongly suggested that the reader refer to the more extensive discussions and presentations of alternatives given in the literature cited and in the references contained therein.

H42 **A Photoionization Mass Spectrometer Study of $CFCl_3$, CF_2Cl_2, and CF_3Cl**

J. M. Ajello, W. T. Huntress, Jr., and P. Rayermann

J. Chem. Phys., Vol. 64, Vol. 11, pp. 4746–4754, June 1, 1976

For abstract, see Ajello, J. M.

HUTCHEON, I. D.

H43 **The Fission Track Record of Apennine Front KREEP Basalts**

E. L. Haines, I. D. Hutcheon (University of California, Berkeley), and J. R. Weiss

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 3527–3540, 1975

For abstract, see Haines, E. L.

JACKSON, E. B.

J01 **DSN Research and Technology Support**

E. B. Jackson

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 132–136, February 15, 1976

The activities at the Venus Station (DSS 13) and the Microwave Test Facility, both operated by the Development Support Group, during the period Oct. 16–Dec 7, 1975 are discussed and progress noted. Continuing testing of the remote-controlled automated station is noted as well as routine pulsar observations. Automatic stability–reliability testing of the station maser–receiver–noise adding radiometer combination is described along with the data collected while so doing. Comparative measurements on the production version of the dichroic plate installed on the 64-m antennas are described along with mention of testing of a National Bureau of Standards radiometer. Engineering measurements on the microwave power transmission test setup are described and a

progress report of the X-Band Radar, Transmit-Receive; K-Band Receive feedcone rehabilitation is given. Special testing of the new design feedcone for the Unified S-Band stations is mentioned, and measurements on interference received from the navigational equipment aboard military or commercial aircraft are described. Reporting of routine maintenance and support of clock synchronization transmissions and various radio science experiments is also included.

J02 DSN Research and Technology Support

E. B. Jackson

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 258–261, April 15, 1976

The activities at the Goldstone Venus Station (DSS 13) and the Microwave Test Facility (MTF), during the period Dec. 8, 1975 through Feb. 15, 1976, are discussed and progress noted. Continuing testing and refinement of the remote controlled automated pulsar observing station is noted, along with routine pulsar observations of 22 pulsars. Automatic stability-reliability testing of the station receiver/maser noise-adding radiometer (NAR) combination is described. An updated discussion of the data being collected by the 24-hour-per-day, seven-day-per-week Solar and Microwave Data Acquisition System (SAMDAS) is presented in which currently available data types are tabulated.

Supporting research activities in support of the X-band radar and stability tests on semirigid coaxial cables are discussed along with preparations for testing of a new design diplexer for future DSN use. The activities of the DSN High-Power Transmitter Maintenance Facility are discussed, and continuing observations of Jupiter at 2295 MHz are reported along with the radio calibration sources used in this program. Routine clock synchronization transmissions are noted along with some engineering measurements and changes directed toward energy conservation.

J03 DSN Research and Technology Support

E. B. Jackson

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 206–211, June 15, 1976

The activities of the Venus Deep Space Station (DSS 13) and the Microwave Test Facility (MTF) during the period February 16 through April 18, 1976 are discussed and progress noted. Continuing testing and refinement of the remote-controlled, unattended automated pulsar observing station is noted, along with routine pulsar observations of 22 pulsars. Radar observations of a geo-stationary satellite are discussed. Current status of the 400-kW X-band radar is reported along with routine automatic testing of the stability reliability of the DSS 13 maser-receiver noise-adding radiometer combination. A failure in the Faraday Rotation Receiving System is noted along with discussion in some detail of the activities of the High Power Transmitter Maintenance Facility. Continuation of receiver phase stability testing, specifically the effects of temperature on coaxial cables, is discussed and results reported. A demonstration at full power of the microwave power transmission facility is noted and routine support of the Planetary Radio Astronomy experiment is discussed. Transmission of master clock synchronization signals to overseas DSN stations is also reported.

J04 DSN Research and Technology Support

E. B. Jackson

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 119–123, August 15, 1976

The activities of the Venus Station (DSS 13) and the Microwave Test Facility (MTF) during the period April 19 through June 13, 1976, are discussed and progress noted. Continuing reliability testing and computer program refinement of the remote controlled, unattended automated pulsar observing station is noted, along with routine observations of 17 pulsars. Radar observations of a geostationary satellite are reported, along with the routine automatic testing of the stability of the DSS 13 maser-receiving system. Additional testing of thermal characteristics of semiflexible coaxial cables is reported, along with phase stabilization measurements thereon. Routine support of the planetary radio astronomy experiment, with 43.25 hours of observations of Jupiter and various radio calibration sources, is reported, along with 18.75 hours of differential VLBI observations in conjunction with Australia, DSS 43. Modifications of the clock synchronization winterization system are reported, along with a discussion of the activities of the DSN High-Power Transmitter Maintenance Facility. A detailed scanning of the orbital region in which geostationary satellites are found is reported as part of the DSN radio frequency interference analysis task.

J05 DSN Research and Technology Support

E. B. Jackson

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 153–156, December 15, 1976

The activities of the Venus Station (DSS 13) and the Microwave Test Facility during the period June 14 through October 10, 1976, are discussed and progress noted. Continuing remote controlled pulsar observations are noted, along with routine observations of 22 pulsars.

Preliminary installation of equipment for planned unattended operation of the Venus Station is reported, along with extensive measurements and performance evaluation of the 26-m antenna. Support of the X-band radar at the Mars Station (DSS 14), and stability and reliability testing of the DSS 13 receiving system are reported. Klystron testing and other DSN support activities of the DSN High-Power Transmitter Maintenance Facility are noted, along with energy conservation modifications to two buildings at DSS 13. Radio Science experiment support included Planetary Radio Astronomy, Pulsar Rotation Constancy, Interstellar Microwave Spectroscopy and Very Long Baseline Interferometry observations. An increased schedule of clock synchronization transmissions, planned on five-day centers, is noted, as 39 transmissions were made to Australia, DSS 43, and Spain, DSS 63.

JACOBSON, R. A.

J06 Statistical Analysis of Trim Maneuvers in Low-Thrust Interplanetary Navigation

G. C. Rinker, R. A. Jacobson, and L. J. Wood (Hughes Aircraft Company)

J. Spacecraft Rockets, Vol. 13, No. 8, pp.509–512, August 1976

For abstract, see Rinker, G. C.

JAGGARD, D. L.

J07 Floquet and Coupled-Waves Analysis of Higher-Order Bragg Coupling in a Periodic Medium

D. L. Jaggard and C. Elachi

J. Opt. Soc. Amer., Vol. 66, No. 7, pp. 674–682, July 1976

We consider wave propagation in longitudinally periodic media near the first- and higher-order Bragg resonances. An extended coupled-waves (ECW) approach is applied to media with single or multiharmonic periodicities and numerically compared to the Floquet theory. The ECW approach predicts coupling coefficients χ that vary as η^N, where η is the magnitude of the perturbation and N is the Bragg order. Explicit expressions are also given for the band-gap width and band-gap shift for all Bragg orders. A number of applications are discussed.

JAIN, A.

J08 Subresolution Imaging: Use of Wavelength and Angular Diversity Techniques

A. Jain

Appl. Phys. Lett., Vol. 28, No. 8, pp. 451–453, April 15, 1976

We calculate the Fourier transform of the electric field at a point on the image of an object as the angle or wavelength of the illumination on the object is varied and show that this function provides a direct measurement of the amplitude and surface height structure of the object within the resolution cell centered at the corresponding point on the object.

JET PROPULSION LABORATORY

J09 Proceedings of the Caltech/JPL Conference on Image Processing Technology, Data Sources and Software for Commercial and Scientific Applications

Jet Propulsion Laboratory

Special Publication 43-30, 1976

The Caltech/JPL Conference on Image Processing Technology, Data Sources and Software for Commercial and Scientific Applications was held at the California Institute of Technology on November 3–5, 1976, under the joint sponsorship of NASA Office of Applications, California Institute of Technology, and Jet Propulsion Laboratory. The conference served as an effective means for disseminating recent advances in image processing technology and included previously unpublished techniques that were developed within JPL's Image Processing Laboratory. Panels were also formed for discussion and analysis of problems of contemporary interest and included representatives from the private sector, the university community, and several NASA centers currently involved in projects that are highly user-oriented.

J10 Proceedings of the Lectures by the Seismological Delegation of the People's Republic of China

Jet Propulsion Laboratory

Special Publication 43-32, August 1, 1976

Four papers from the People's Republic of China report the successful prediction of and studies pursuant to the 1975 Haicheng earthquake. The topics include the prediction of the quake, its characteristics, general earthquake studies in China, and earthquake resistivity of factory structures. Editors' and translators' notes are included, and a collection of earthquake photographs from the Haicheng area is presented.

J11 Sharing Criteria and Performance Standards for the 11.7–12.2 GHz Band In Region 2

Jet Propulsion Laboratory

Special Publication 43-35, May 24, 1976

As a result of the 1973 Plenipotentiary Conference of the International Telecommunication Union resolution to convene a World Administrative Radio Conference for the Planning of the Broadcasting-Satellite Service in the 12-GHz band, several working groups were established. The report of the group on Sharing Criteria examines the characteristics and requirements of domestic Broadcasting- and Fixed-Satellite systems, defines sharing criteria, and explores the possibility of adopting performance standards for the 11.7- to 12.2-GHz band.

J12 Solar Cell Array Design Handbook

Jet Propulsion Laboratory

Special Publication 43-38, Vol. I, October 1976

The Solar Cell Array Design Handbook is written at a practicing engineering level and provides a comprehensive compilation of explanatory notes, design practices, analytical models, solar cell characteristics, and material properties data of interest to personnel engaged in solar cell array performance specification, hardware design, analysis, fabrication and test. Twelve handbook chapters discuss the following: historical developments, the environment and its effects, solar cells, solar cell filters and covers, solar cell and other electrical interconnections, blocking and shunt diodes, substrates and deployment mechanisms, material properties, design synthesis and optimization, design analysis, procurement, production and cost aspects, evaluation and test, orbital performance, and illustrative design examples. A comprehensive index permits rapid locating of desired topics. The handbook consists of two volumes: Volume I is of an expository nature while Volume II contains detailed design data in an appendix-like fashion. Volume II includes solar cell performance data, applicable unit conversion factors and physical constants, and mechanical, electrical, thermal, optical, magnetic, and outgassing material properties. Extensive references are provided.

J13 Solar Cell Array Design Handbook

Jet Propulsion Laboratory

Special Publication 43-38, Vol. II, October 1976

The Solar Cell Array Design Handbook is written at a practicing engineering level and provides a comprehensive compilation of explanatory notes, design practices, analytical models, solar cell characteristics, and material properties data of interest to personnel engaged in solar cell array performance specification, hardware design, analysis, fabrication and test. Twelve handbook chapters discuss the following: historical developments, the environment and its effects, solar cells, solar cell filters and covers, solar cell and other electrical interconnections, blocking and shunt diodes, substrates and deployment mechanisms, material properties, design synthesis and optimization, design analysis, procurement, production and cost aspects, evaluation and test, orbital performance, and illustrative design examples. A comprehensive index permits rapid locating of desired topics. The handbook consists of two volumes: Volume I is of an expository nature while Volume II contains detailed design data in an appendix-like fashion. Volume II includes solar cell performance data, applicable unit conversion factors and physical constants, and mechanical, electrical, thermal, optical, magnetic, and outgassing material properties. Extensive references are provided.

J14 Proceedings of the Conference on Charge-Coupled Device Technology and Applications

Jet Propulsion Laboratory

Special Publication 43-40, November 1976

These Proceedings present the papers given at the Conference on Charge-Coupled Device Technology and Applications held at the Sheraton Park Hotel, Washington, D. C., November 30 through December 2, 1976. Conference sessions were devoted to the following topics: Data Processing; Infared; Devices and Testing; Electron-In, X-Ray, Radiation; and Applications. The conference was jointly sponsored by the Office of Aeronautics and Space Technology, National Aeronautics and Space Administration, and the Jet Propulsion Laboratory, California Institute of Technology.

J15 Mariner Venus-Mercury 1973 Project Final Report: Venus and Mercury I Encounters

Jet Propulsion Laboratory

Technical Memorandum 33-734, Vol. I, September 15, 1976

This document is Volume I of a two-volume report covering the Mariner Venus-Mercury 1973 Project. Volume I covers that portion of the project defined as the Primary Mission, which includes the Venus encounter and the first Mercury encounter. The document describes the plans and activities undertaken to successfully achieve the mission objectives. The operational activities are identified by Mission Operation System (MOS) functions, providing a brief summary of each discipline. Spacecraft performance is summarized by subsystems.

J16 10th Aerospace Mechanisms Symposium: April 22–23, 1976

Jet Propulsion Laboratory

Technical Memorandum 33-777, July 1, 1976

The Tenth Aerospace Mechanisms Symposium was held at the Jet Propulsion Laboratory in Pasadena, California on April 22 and 23, 1976. The symposium was sponsored

jointly by the National Aeronautics and Space Administration, the Lockheed Missiles and Space Company, Inc., and the California Institute of Technology. These symposia are meetings specifically devoted to the design, fabrication, test, and operational use of mechanisms, and provide a forum for interchange among those active in the field of mechanism engineering and technology. The 21 formal presentations represent contributions from NASA Research Centers and both United States and foreign industrial and research groups.

JOHNS, C. E.

J17 Phase-Stable Receiver Development

C. E. Johns

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 241–246, April 15, 1976

Physical changes in coaxial cable parameters cause corresponding phase variations to RF signals being transmitted through them. In some types of receivers, these variations directly affect the information signal. A phase-correcting circuit has been developed which greatly reduces the cable effects upon an RF signal. This article describes two types of correcting loops and test results from breadboard units.

J18 Pioneer Venus Entry Simulator

C. E. Johns

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 155–158, June 15, 1976

To assure successful tracking of the four Pioneer Venus probes, it is necessary for the deep space station receiver operators to be familiar with the characteristics of the received signals. As an aid for training the operators for this mission, signal simulators have been developed which completely duplicate the probe signals. This article describes the method used for generating these test signals.

JOHNSON, D. L.

J19 An Algebraic Approach to Image De-smearing: Symmetries of Polynomials and Their Zeros

D. L. Johnson

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 58–63, October 15, 1976

Frequently a photograph received from a spacecraft will be "smeared" by some process, e.g., by camera motion. Algebraically such smearing can be represented as $p = \sigma f$, where σ is the true picture, p is the received picture, and f is the smearing function. (p, σ, and f are polynomials in two variables x and y.) Thus, in principle, σ can be recovered by multiplying p by $1/f$. However, there are problems involved in computing $1/f$; this paper investigates some of them.

JOHNSON, T. V.

J20 Io's Atmosphere and Ionosphere: New Limits on Surface Pressure From Plasma Models

T. V. Johnson, D. L. Matson, and R. W. Carlson (University of Southern California)

Geophys. Res. Lett., Vol. 3, No. 6, pp. 293–296, June 1976

We have studied charge particle impact as a mechanism for the production of Io's ionosphere. Pioneer 10 thermal plasma measurements and magnetospheric plasma models which explain the observed spatial distribution of neutral hydrogen and sodium atoms in the vicinity of Jupiter's satellite Io imply electron fluxes of $\sim 10^{10}$ cm^{-2} sec^{-1}. The fluxes and the temperature ($\sim$100 eV) of this plasma suggest that electron impact ionization is the dominant process in forming the ionosphere of Io It is found that the surface number density of the neutral species required to match the observed electron density profiles is $\sim 10^{9}$ cm^{-3} or less. This value is two orders of magnitude lower than previous estimates.

J21 Photometry of 433 Eros From 0.65 to 2.2 μm

G. J. Veeder, D. L. Matson, J. T. Bergstralh, and T. V. Johnson

Icarus, Vol. 28, No. 1, pp. 79–85, May 1976

For abstract, see Veeder, G. J.

J22 Vidicon Spectral Imaging: Color Enhancement and Digital Maps

T. V. Johnson, D. L. Matson, R. J. Phillips, and R. S. Saunders

Proc. Sixth Lunar Sci. Conf. (Suppl. 6 *Geochim. Cosmochim. Acta*), pp. 2677–2688, 1975

We present visible and near-infrared spectral imaging data for a lunar region (400 × 400 km) which includes the Serenitatis–Tranquillitatis border. Images were acquired with a silicon imaging photometer system (SIPS) in four narrow bandpasses (λ_c = 0.38, 0.56, 0.85, and 1.05 μm). Three ratio frames were used to make color composites of ratio images. In addition, spectral maps based on an interactive "cluster" analysis were produced from four video channels. Comparison of SIPS data with previous photoelectric spectrophotometry shows good

agreement and several distinct spectral types are identified in the Serenitatis Standard area. A low albedo, titanium-poor unit occurs near the southern edge of the Serenitatis and south of the basin; this unit appears to postdate the high-titanium, dark Tranquillitatis and "blue ring" material and may be associated with an Al/Si anomaly noticed in Apollo orbital X-ray data.

JOHNSTON, A. R.

J23 Bit Error Rate Measurement for Evaluation of a Fiber Optic Link

L. A. Bergman and A. R. Johnston

Proc. SPIE Conf. Fibers & Integrated Opt., Reston, Va., Mar. 22–23, 1976, Vol. 77, pp. 78–86

For abstract, see Bergman, L. A.

JOHNSTON, D. W.

J24 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 9–10, February 15, 1976

For abstract, see Mudgway, D. J.

J25 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 8–20, June 15, 1976

For abstract, see Mudgway, D. J.

J26 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 4–20, August 15, 1976

For abstract, see Mudgway, D. J.

J27 Viking Mission Support

R. J. Amorose and D. W. Johnston

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 11–19, October 15, 1976

For abstract, see Amorose, R. J.

J28 Viking Mission Support

D. W. Johnston and T. W. Howe

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 13–21, December 15, 1976

This report covers the most significant Viking Mission events supported by the DSN during August and September 1976. Intermediate data production and DSS support are also summarized for this period. Viking DSN Discrepancy Report activity for the period January 1975 through September 1976 is also included.

JONES, A. D., III

J29 Spectral Properties of Hydrogen, Helium, Methane, and Ammonia at Thermal Infrared Wavelengths

F. W. Taylor and A. D. Jones III

Icarus, Vol. 29, No. 2, pp. 299–306, October 2, 1976

For abstract, see Taylor, F. W.

J30 Optical Constants of Sulphuric Acid in the Far Infrared

A. D. Jones III

J. Quant. Spectros. Radiat. Transfer, Vol. 16, No. 12, pp. 1017–1019, December 1976

The IR absorption spectrum of a 75% sulphuric acid solution is obtained experimentally in the 20–50 μm wavelength region. The complex refractive index ($n = n_r - in_i$) is determined from these measurements by integration of the Kramers–Kronig dispersion relation. The application of this data to radiative transfer processes in the atmosphere of Venus is briefly discussed.

JONES, J. B.

J31 Optimal Rendezvous in the Neighborhood of a Circular Orbit

J. B. Jones

J. Astronaut. Sci., Vol. XXIV, No. 1, pp. 55–90, January–March 1976

The minimum ΔV rendezvous solutions, when the motion may be linearized about a circular orbit, fall into two separate regions: the Phase-for-free Region and the General Region. Phase-for-free solutions are derived from the optimum transfer solutions, require the same ΔV expenditure, but may not be unique. Analytic solutions are presented in two of the three subregions. An algorithm is presented for determining the unique solutions in the General Region. Various sources of initial conditions are discussed and three examples presented.

JONES, M.

J32 The Electrical and Magnetic Properties of $(TTF)(I)_{0.71}$

R. B. Somoano, A. Gupta, V. Hadek, T. Datta (Tulane University), M. Jones (Tulane University), R. Deck (Tulane University), and A. M. Hermann (Tulane University)

J. Chem. Phys., Vol. 63, No. 11, pp. 4970–4976, December 1, 1975

For abstract, see Somoano, R. B.

JORDAN, T. M.

J33 Improved Space Radiation Shielding Methods

H. S. Davis and T. M. Jordan

Technical Memorandum 33-765, March 1, 1976

For abstract, see Davis, H. S.

JURGENS, R. F.

J34 Theory, Operation, and Computer Programming of the 512-Lag Correlator System

R. F. Jurgens

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 164–177, April 15, 1976

The theory, operation, and computer programming of the JPL–Haystack auto-crosscorrelator system is described. This system provides 512 channels with a basic bandwidth of 10 MHz and has provisions for multilevel sampling, oversampling, and bandwidth multiplication by factors of 2 and 4. The system controller features automatic word extension to 40 bits, precise control of the zero lag counter, and computer-enabled run or start commands.

J35 Three-Level Sampler Having Automated Thresholds

R. F. Jurgens

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 52–57, October 15, 1976

A three-level sampler is described that has its thresholds controlled automatically so as to track changes in the statistics of the random process being sampled. In particular, the mean value is removed and the ratio of the standard deviation of the random process to the thresholds is maintained constant. The system is configured in such a manner that slow drifts in the level comparators and digital-to-analog converters are also removed. The ratio of the standard deviation to threshold level may be chosen within the constraints of the ratios of two integers N and M. These may be chosen to minimize the quantizing noise of the sampled process. Proper ratios have been given by Rodemich for gaussian random processes.

J36 Radar Observations at 3.5 and 12.6 cm Wavelength of Asteroid 433 Eros

R. F. Jurgens and R. M. Goldstein

Icarus, Vol. 28, No. 1, pp. 1–15, May 1976

A study of the asteroid 433 Eros using 3.5 and 12.6 cm radar waves indicates that the surface is very much rougher than any planetary or lunar surface observed by this method. A surface completely covered with sharp edges, pits, subsurface holes, or embedded chunks with scale sizes on the order of our wavelengths seems to be indicated. A model based on a rough rotating triaxial ellipsoid having radii in the rotation equator of 18.6 and 7.9 km agrees well with our data, although a strong wobble in the apparent center frequency of the spectra as rotation progresses indicates that one side may be more reflective than the other, or more likely, that the projected axis of rotation does not equally divide the projected area.

KAHLE, A. B.

K01 Thermal Inertia Imaging: A New Geologic Mapping Tool

A. B. Kahle, A. R. Gillespie, and A. F. H. Goetz

Geophys. Res. Lett., Vol. 3, No. 1, pp. 26–28, January 1976

A thermal model of the Earth's surface has been developed and used to determine the thermal inertia of a test site in the Mojave Desert, California. The model, which includes meteorological heating terms as well as radiation and conduction heating terms, is used with remotely sensed surface temperature and reflectance data to determine the thermal inertia of the surface materials at the test site. The thermal inertia is displayed in image form, and can aid in the differentiation of the various lithologic materials in the test site. Since this thermal property is representative of the upper several cm of the surface, it complements visible and reflected near-IR image data.

K02 Thermal Inertia Mapping

A. B. Kahle, A. R. Gillespie, A. F. H. Goetz, and J. D. Addington

Proc. Tenth Int. Symp. Remote Sensing of Environ., Univ. of Michigan, Ann Arbor, Mich., Oct. 6–10, 1975, pp. 985–994

A thermal model of the Earth's surface has been developed and used to determine the thermal inertia of a test site in the Mojave Desert, California. The model, which includes meteorological heating terms as well as radiation and conduction heating terms, is used with remotely sensed surface temperature data to determine thermal inertia of materials. The thermal inertia is displayed in image form, and can aid in the differentiation of the various lithologic materials in the test site.

KAKAR, R. K.

K03 Venus: Microwave Detection of Carbon Monoxide

R. K. Kakar, J. W. Waters, and W. J. Wilson (Aerospace Corporation)

Science, Vol. 191, No. 4225, pp. 379–380, January 30, 1976

The 115-gigahertz microwave line of carbon monoxide has been detected in the spectrum of Venus. The measurement proves that the carbon monoxide mixing ratio increases above an altitude of 85 kilometers in the Venus stratosphere and provides quantitative information on carbon monoxide in the altitude region from 80 to 110 kilometers. This altitude region is well above that which has been previously sensed.

KALFAYAN, S. H.

K04 Accelerated Heat-Aging Studies on Fluorosilicone Rubber

S. H. Kalfayan, R. H. Silver, and A. A. Mazzeo

Rubber Chem. Technol., Vol. 48, No. 5, pp. 944–952, November–December 1975

The accelerated heat aging of a vulcanizate of fluorosilicone rubber was studied using four methods: (1) infrared spectroscopy, (2) gel permeation chromatography, (3) weight-loss measurements, and (4) stress-relaxation measurements. The purpose of the study was to gather information concerning the nature and extent of the chemical changes that take place in elastomers during the aging process. The article discusses the data obtained from the four types of measurements made.

K05 Accelerated Heat-Aging Studies on Fluororubber in Various Media

S. H. Kalfayan, R. H. Silver, and S. S. Liu

Rubber Chem. Technol., Vol. 49, No. 4, pp. 1001–1009, September–October 1976

The accelerated aging of a diamine vulcanized fluorocarbon rubber (FKM) was studied by the following methods: infrared spectroscopy, GPC, swelling and stress relaxation, with the purpose of gathering information pertinent to understanding the basic mechanism of its aging. Stress relaxation measurements showed that when FKM undergoes accelerated aging in air, both scission and crosslinking take place. The principal site of scission is at the crosslinks, and not in the backbone chain. Intermittent stress relaxation measurements indicate that crosslinks form during thermal aging in both air and nitrogen, their rate first increasing and then leveling off.

KATOW, M. S.

K06 Proposed Modifications to the Wind Loading Specifications Applied to Ground Antennas

M. S. Katow

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 65–69, April 15, 1976

As the survival wind velocity specification mainly controls the final weight of the reflector structure of a ground antenna, this study of the latest wind data shows that the survival specification can be lowered, and therefore the weight can be lowered, from 53.0 m/s (120 mi/h) to less than 44.1 m/s (100 mi/h). The results are based on analysis methods as recommended by the existing design guides. However, the next study reporting will be based on considerations of the dynamic action of wind, which is the upgraded analysis method described in the literature.

K07 Foundation Analysis, Preliminary Investigation

H. McGinness and M. S. Katow

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 81–85, April 15, 1976

For abstract, see McGinness, H.

K08 Radio-Frequency Boresight Analysis of the Low-Cost 64-Meter Antenna

M. S. Katow

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 128–135, October 15, 1976

Two configurations of the reflector-only assemblies, using different width backup cones, are analyzed for RF boresight direction changes and wind distortions. The wider

backup cone is best for minimum weight; however, there is an optimum weight which minimizes the RF boresight errors for a wind load that produces the maximum pitching moment of both configurations.

KEESEY, M. S. W.

K09 JPL Development Ephemeris Number 96

E. M. Standish, Jr., M. S. W. Keesey, and X X Newhall

Technical Report 32-1603, February 29, 1976

For abstract, see Standish, E. M., Jr.

KELLEY, J. H.

K10 Hydrogen Energy Systems Technology Study

J. H. Kelley

Int. J. Hydrogen Energy, Vol. 1, No. 2, pp. 199–204, June 30, 1976

The Hydrogen Energy Systems Technology Study found current U.S. hydrogen utilization to be dominated by chemical-industry and petroleum-processing applications, and to represent 3% of total energy consumption. The study's projections of hydrogen uses show growth the remainder of this century by at least a factor of five, and perhaps a factor of twenty. New applications in the manufacture of synthetic fuels from coal and directly as an energy storage medium and fuel are expected to emerge later this century. Of these new uses, electric utility energy storage for peak-shaving, supplements to the natural gas supply and special purpose transportation fuel such as aircraft show promise The study concludes that the development and implementation of new means of supplying hydrogen, replacing the use of natural gas and petroleum feedstocks, are imperative. New production technology is essential to support even the lowest growth estimate. Methods based on alternative fossil feedstocks, such as coal and heavy oils, which are less expensive and nearer to technical maturity than non-fossil production systems, should be made operational while these feedstocks are abundant. Concurrently, the long-term tasks of advancing electrolysis technology, researching other water-splitting techniques, and integrating these with developing nuclear and emerging solar primary-energy systems, must be carried on, together with work on hydrogen combustion systems and research in materials and safety engineering. Systems studies and assessments of the economic, social and environmental impacts of hydrogen technology are also called for.

KELLEY, M. C.

K11 Properties of ELF Electromagnetic Waves in and Above the Earth's Ionosphere Deduced From Plasma Wave Experiments on the OV1-17 and OGO 6 Satellites

M. C. Kelley (Cornell University), B. T. Tsurutani, and F. S. Mozer (University of California, Berkeley)

J. Geophys. Res., Space Phys., Vol. 80, No. 34, pp. 4603–4611, December 1, 1975

An analysis of ac electric field data obtained on board the OV1-17 satellite and ac magnetic field data obtained on board the Ogo 6 satellite has been made during the northern hemisphere spring and summer of 1969 with the purpose of studying extreme low frequency (ELF) electromagnetic waves above the earth's ionosphere. The results are in basic agreement with a number of previous ground-based and low-altitude satellite experiments in that the peak signal was observed at high latitudes outside the statistical location of the plasmapause on the day side of the earth, that ELF chorus was very often observed in conjunction with the steady ELF hiss emissions, that the winter hemisphere signal was considerably smaller than that observed in summer or in equinoctial months, and that the emission strength and region of occurrence are asymmetric about magnetic noon. Observations of such strong hiss signals outside the plasmasphere are somewhat surprising in light of Ogo 3 and Ogo 5 measurements which show steady ELF hiss to be closely confined to the plasmasphere at high altitudes during normal circumstances. The present study supports the hypothesis that hiss leaks out of the plasmasphere and refracts downward into the lower ionosphere; such a model predicts the observed summer-winter asymmetry and the poleward skewing of the ELF peak signal strength with decreasing altitude. The observation reported here that the high-latitude boundary for ELF signals in the ionosphere is very near the low-latitude boundary for long-wavelength ionospheric irregularities and, at least in the morning hours, very near the horizontal density gradient due to precipitation of magnetosheath plasma in the cusp suggests that these variations in the medium act to reflect the waves and to increase the high-latitude intensity further. The relationship between signal strength and magnetic activity shown by these data is in agreement with other *in situ* measurements but not with some ground-based data. It is argued, however, that the anticorrelation observed at high-latitude ground stations is due to an equatorward displacement of the peak wave intensity region with increasing magnetic activity, such an equatorward displacement is shown in our results. It is also shown that a significant component of wave electric field is parallel to the wave number k and hence that Landau resonant effects may

occur at low altitudes between outer zone radiation belt particles and ELF hiss.

KENNY, J. T.

K12 **Sustained Load Crack Growth Design Data for Ti-6Al-4V Titanium Alloy Tanks Containing Hydrazine**

J. C. Lewis and J. T. Kenny (Martin Marietta Aerospace)

Technical Report 32-1606, September 15, 1976

For abstract, see Lewis, J. C.

KENT, S. S.

K13 **Viking Telecommunication Effects of GEOS Satellite Interference Based on Testing at the Madrid Deep Space Station**

F. V. Stuhr, S. S. Kent, J. L. Galvez, B. G. Luaces, G. R. Pasero, and J. M. Urech

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 60–74, August 15, 1976

For abstract, see Stuhr, F. V.

KEYSER, L. F.

K14 **Heterogeneous Reaction of Ozone With Aluminum Oxide**

L. F. Keyser

Technical Memorandum 33-782, August 15, 1976

Rates and collision efficiencies for ozone decomposition on aluminum oxide surfaces were determined. Samples were characterized by BET surface area, X-ray diffraction, particle size, and chemical analysis. Collision efficiencies were found to be 2×10^{-9} to 2×10^{-10}. This is many orders of magnitude below the value of 10^{-6} to 10^{-5} needed for appreciable long-term ozone loss in the stratosphere. An activation energy of 7.2 kcal mole^{-1} was found for the heterogeneous reaction between −40°C and +40°C. Effects of pore diffusion, outgassing and treatment of the aluminum oxide with several chemical species were also investigated.

KIEFFER, H. H.

K15 **Infrared Thermal Mapping of the Martian Surface and Atmosphere: First Results**

H. H. Kieffer (University of California, Los Angeles), S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, F. D. Palluconi, G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and T. Z. Martin (University of California, Los Angeles)

Science, Vol. 193, No. 4255, pp. 780–786, August 27, 1976

The Viking infrared thermal mapper measures the thermal emission of the martian surface and atmosphere and the total reflected sunlight. With the high resolution and dense coverage being achieved, planetwide thermal structure is apparent at large and small scales. The thermal behavior of the best-observed areas, the landing sites, cannot be explained by simple homogeneous models. The data contain clear indications for the relevance of additional factors such as detailed surface texture and the occurrence of clouds. Areas in the polar night have temperatures distinctly lower than the CO_2 condensation point at the surface pressure. This observation implies that the annual atmospheric condensation is less than previously assumed and that either thick CO_2 clouds exist at the 20-kilometer level or that the polar atmosphere is locally enriched by noncondensable gases.

KIM, J. K.

K16 **Comments on "Reactions of Excited and Ground State H_3^+ Ions With Simple Hydrides and Hydrocarbons"**

V. G. Anicich (University of Utah), J. H. Futrell (University of Utah), W. T. Huntress, Jr., and J. K. Kim

Int. J. Mass Spectrom. Ion Phys., Vol. 18, No. 1, pp. 63–64, September 1975

For abstract, see Anicich, V. G.

KIM, K.

K17 **Blast Wave in a Nozzle for Propulsive Applications**

G. Varsi, L. H. Back, and K. Kim

Acta Astronautica, Vol. 3, Nos. 1/2, pp. 141–156, January/February 1976

For abstract, see Varsi, G.

K18 **Measurement of Detonation Propulsion in Helium and Performance Calculations**

K. Kim, L. H. Back, and G. Varsi

AIAA J., Vol. 14, No. 3, pp. 310–312, March 1976

Results of detonation propulsion are extended to helium as the ambient gas to help in the assessment of performance in the atmospheres of the major planets. Measurements confirm benefits derived from detonating propellant over conventional chemical rocket propulsion. Benefits, however, are reduced at high pressures in a low molecular weight gas. Numerical calculations by means of a monodimensional hydrodynamic code follow the different trends obtained experimentally for high and low molecular weight gases and also offer new insights on the time behavior of the process.

KIMBALL, K. R.

K19 Implementation of Wideband Digital Recording Equipment in the DSN

K. R. Kimball

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 96–104, February 15, 1976

The DSN is implementing wideband digital recording equipment for mission support in the 1978–1981 time era. This article describes the development status of this equipment and the factors which were of major importance in the design approach. Design of equipment is discussed to the functional block diagram level.

KINDT, D. H.

K20 Requirements and Capabilities for Planetary Missions: Venus Orbiter Imaging Radar 1983

D. H. Kindt, G. G. Ball, and T. H. Bird

Special Publication 43-27, Vol. 3, August 1976

The requirements and capabilities are summarized for an imaging radar mission to orbit Venus in 1983. The spacecraft concepts being considered are described, including the scientific experiments. Launch, arrival, and orbital data are presented, and data management for the mission is discussed.

KLAASEN, K. P.

K21 Mercury's Rotation Axis and Period

K. P. Klaasen

Icarus, Vol. 28, No. 4, pp. 469–478, August 1976

Recent measurements made from high-resolution Mariner 10 photography of the planet Mercury yield a rotation period of 58.6461 ± 0.005 days, in excellent agreement with the period required for a precise 2/3 resonance with its orbital period (58.6462 days). The axis of rotation of the planet was calculated to be offset about 2 deg from the perpendicular to its orbital plane within a 50% probability error ellipse of ±2.6 by ±6.5 deg. Dynamical considerations make it most likely that the true displacement from the orbit normal is less than 1 deg.

KLASS, M. J.

K22 Design Criteria for Noncoherent Gaussian Channels With MFSK Signaling and Coding

S. A. Butman, I. Bar-David (Israel Institute of Technology), B. K. Levitt, R. F. Lyon (Stanford Telecommunications, Inc.), and M. J. Klass (University of California, Berkeley)

IEEE Trans. Commun., Vol. COM-24, No. 10, pp. 1078–1088, October 1976

For abstract, see Butman, S. A.

KLEIN, M.

K23 The Problem of Spiral Galaxies and Satellite Radio Sources

H. Arp (Hale Observatories), R. Carpenter, S. Gulkis, and M. Klein

Astrophys. J., Vol. 205, No. 3, pp. 721–727, May 1, 1976

For abstract, see Arp, H.

KLEIN, M. J.

K24 The Variability of the Total Flux Density and Polarization of Jupiter's Decimetric Radio Emission

M. J. Klein

J. Geophys. Res., Space Phys., Vol. 81, No. 19, pp. 3380–3382, July 1, 1976

Results from the first 3 years of a continuing program to monitor time variations in the intensity and polarization of the 13-cm synchrotron emission from Jupiter's radiation belts are reported. After 3 or 4 years of reduced emission at decimetric wavelengths the 13-cm flux density began to increase during 1973, and the increase accelerated throughout 1974. At the time of the Pioneer 11 encounter, the synchrotron emission was ~15% greater than it was during the Pioneer 10 encounter. When the new data are combined with previously published 11- and 21-cm measurements, it is apparent that the nature of the time variations during the past 13 years is similar but not identical at these wavelengths and that there is no convincing evidence that the variations are correlated with either solar activity or Jupiter's distance from the sun. During the same time interval, measure-

ments of the peak degree of linear polarization of the synchrotron emission, with one exception, remained constant near 24.5%.

KLIORE, A. J.

K25 Temperature of the Atmosphere of Jupiter From Pioneer 10/11 Radio Occultations

A. J. Kliore, P. M. Woiceshyn, and W. B. Hubbard (University of Arizona)

Geophys. Res. Lett., Vol. 3, No. 3, pp. 113–116, March 1976

Radio occultation data from the flybys of Pioneer 10 and 11 have been analyzed using a technique which accounts for the oblateness of Jupiter's atmosphere. The center of refraction is located by the radius of curvature and the normal at the closest approach point of the ray. An Abelian inversion of the data is then carried out holding the center of refraction fixed at some average value for each occultation event. Applying this approximate theory, for the three measurements described, the results are consistent, showing a temperature inversion between the 10- and 100-mb levels, with temperatures between 130 and 170 K at the 10-mb level and 80 to 120 K at 100 mb. These results are also in agreement with models for the temperature in the Jovian atmosphere derived from Pioneer 10 infrared radiometer data as well as those constructed from radiative-convective balance calculations. Nevertheless, all results derived from radio occultation measurements of Jupiter are ultimately limited in their validity at the highest pressures by a lack of detailed knowledge of the shape of isobaric contours in Jupiter's atmosphere.

KNAPP, G. R.

K26 The Radio Spectrum, Electron Temperature and Ionizing Flux of the H II Region IC 5146

T. B. H. Kuiper, G. R. Knapp (California Institute of Technology), and E. N. R. Kuiper (University of California, Los Angeles)

Astron. Astrophys., Vol. 48, No. 3, pp. 475–477, May 1976

For abstract, see Kuiper, T. B. H.

K27 Observations of Heavy-Element Recombination Lines in the Rho Ophiuchi Dark Cloud at 13 Centimeters Wavelength

G. R. Knapp (California Institute of Technology), T. B. H. Kuiper, and R. L. Brown (National Radio Astronomy Observatory)

Astrophys. J., Vol. 206, No. 1, pp. 109–113, May 15, 1976

High-sensitivity observations at the carbon 140α and 141α recombination-line frequencies in the direction of the ρ Oph dust cloud show the presence of recombination lines of carbon and sulfur, but not of other heavy elements. These results require that the elements Si, Fe, and Mg are depleted by factors greater than 15, 10, and 2, respectively, most likely into interstellar grains, whereas sulfur is undepleted: and that only approximately one-sixth of the carbon is present in the gas phase in the cloud. From the observed size of the C II region, $\theta \approx 3.2'$, together with the observed carbon depletion, we infer that the density in the carbon-line-emitting region is $n(\mathrm{H}) \approx 2.5 \times 10^4$ cm^{-3}, and that the size of the S II region is significantly larger than that of the C II region. The agreement between the widths of the recombination lines (which arise in a small region of the cloud) and those of the more widely distributed molecular species suggests that the lines in this cloud are broadened by microturbulence on a scale $\ll 0.1$ pc.

K28 CO Observations of the Expanding Envelope of IRC + 10216

T. B. H. Kuiper, G. R. Knapp (California Institute of Technology), S. L. Knapp (California Institute of Technology), and R. L. Brown (National Radio Astronomy Observatory)

Astrophys. J., Vol. 204, No. 2, pp. 408–414, March 1, 1976

For abstract, see Kuiper, T. B. H.

KNAPP, S. L.

K29 CO Observations of the Expanding Envelope of IRC + 10216

T. B. H. Kuiper, G. R. Knapp (California Institute of Technology), S. L. Knapp (California Institute of Technology), and R. L. Brown (National Radio Astronomy Observatory)

Astrophys. J., Vol. 204, No. 2, pp. 408–414, March 1, 1976

For abstract, see Kuiper, T. B. H.

KNOELL, A. C.

K30 Modular Disposable Can (MODCAN) Crash Cushion: A Concept Investigation

A. C. Knoell and A. H. Wilson

Technical Memorandum 33-795, August 15, 1976

This paper presents details concerning a conceptual design investigation of an improved highway crash cushion system. The sytem is referred to as a modular disposable can (MODCAN) crash cushion. It is composed of a modular arrangement of disposable metal beverage cans configured to serve as an effective highway impact attenuation system. Experimental data, design considerations, and engineering calculations supporting the design development are presented. Design performance is compared to that of a conventional steel drum system. It is shown that the MODCAN concept offers the potential for smoother and safer occupant deceleration for a larger class of vehicle impact weights than the steel drum device.

K31 Graphite Fiber Reinforced Bone Cement

A. C. Knoell H. Maxwell, and C. Bechtol (Join Implant Surgery and Research Foundation, Los Angeles)

Ann. Biomed. Eng., Vol. 3, No. 2, pp. 225–229, June 1975

This paper presents the results of a brief experimental investigation to determine the effects of graphite fiber additives on the flexural, compressive, and exothermal characteristics of surgical bone cement. The materials used in the investigation were polymethylmethacrylate (PMM) and chopped graphite (GY70) fibers. Both fiber reinforced and unreinforced beam and cylinder specimens were fabricated and tested. The unreinforced specimens were used to develop baseline data. Comparison of static test data indicated that the graphite fiber additives yielded a twofold increase in stiffness without compromising the flexural strength of the material. The compressive strength decreased significantly, however, as a result of poor specimen compaction and the resulting presence of voids. The maximum exothermic temperature developed in the fiber reinforced specimens was approximately half that of the basic PMM. It is concluded that graphite fiber reinforcement is beneficial in improving certain mechanical and thermal properties of surgical bone cement. However, considerable effort remains to produce a clinically usable graphite fiber reinforced bone cement.

K32 Evaluation of Boron/Aluminum Tubes in Compression

A. C. Knoell

J. Spacecraft Rockets, Vol. 12, No. 10, pp. 635–637, October 1975

Considerable attention has recently been given to the development and application of boron/aluminum (B/Al) composite material to aircraft and spacecraft structures. The results of these investigations and others have shown that B/Al offers the potential of improved structural performance at reduced weight when compared to conventional metal counterpart structures. Furthermore, these investigations have also indicated that such improved performance can be confidently and economically gained as a result of improved fabrication techniques and more widespread usage of the material. Using these results, a brief analytical and experimental investigation was performed to determine the compressive behavior of B/Al tubes. The investigation consisted of determining the full scale column and local crippling strengths of six B/Al tubes. The purpose of the investigation was to gain hardware experience in a limited evaluation of the material for application to spacecraft truss structures. It was recognized that the results of this investigation could also be coupled with other available analytical and experimental data on B/Al, thereby contributing at least in a small manner to an expanded data base of the material. This Note presents the results of that investigation.

KOBLE, H. M.

K33 LS 44—An Improved Deep Space Network Station Location Set for Viking Navigation

H. M. Koble, G. E. Pease, and K. W. Yip

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 79–98, October 15, 1976

Improved estimates for the spin axis and longitude components of the Deep Space Network station locations have been obtained from post-flight processing of radio metric data received from various Mariner planetary missions. The use of an upgraded set of ionospheric calibrations and the incorporation of near-Venus and near-Mercury radio metric data from the Mariner 10 spacecraft are the principal contributing effects to the improvement. These new estimates, designated Location Set (LS) 44, have supported Viking navigation activities in the vicinity of Mars. As such, the station locations have been determined relative to the planetary positions inherent in JPL Development Ephemeris (DE) 84, which has been used throughout the Viking mission. The article also presents and discusses a version of LS 44 based upon the latest planetary ephemeris, DE 96.

KOLBLY, R. B.

K34 DSN Diplexer, Noise Burst Testing

R. B. Kolbly

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 199–205, June 15, 1976

This article describes the testing of a new design high power S-band diplexer, the megawatt Cassegrain diplexer (MCD), to be used for DSN operations. The tests described were performed at 100 kW at the Venus Deep Space Station (DSS 13) Transmitter Test Area. At 100 kW or less no degradation of receive performance was detected.

KOLLAR, F. J.

K35 Viking X-Band Telemetry Expériment Final Report

W. J. Weber III, W. E. Ackerknecht III, and F. J. Kollar

Technical Memorandum 33-794, September 1, 1976

For abstract, see Weber, W. J., III

KOMAREK, T.

K36 Terminology of Ranging Measurements and DSS Calibrations

T. Komarek and T. Y. Otoshi

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 35–40, December 15, 1976

This article presents a proposed set of basic terminology related to deep space ranging measurements. Calibration equations are derived for the "dish-mounted zero delay device" method for 26-m antenna systems and the "translator" method for 64-m antenna systems.

KORBULY, D. K.

K37 A New Approach to Coding Displayed Mathematics for Photocomposition

D. K. Korbuly

IEEE Trans. Prof. Commun., Vol. PC-18, No. 3, pp. 283–287, September 1975

An applications program called TEXTCOMP has been developed by the Technical Information and Documentation Division, Jet Propulsion Laboratory (JPL), for use in conjunction with Alphanumeric Publication Systems' Comp-2 photocomposition program. TEXTCOMP, written in the Comp-2 language, is designed to accommodate the wide variety of complex page formats and other production requirements typically encountered in JPL's scientific and engineering documentation.

This documentation ranges from straight textual narratives to exceedingly complex technical explanations and descriptions with significant amounts of displayed mathematics. Inherent in all displayed mathematics is an unlimited variety in alignments, horizontal and vertical spacing, and widths and heights of individual characters. Since the photocomposition system for which the TEXTCOMP applications program was written was not designed to perform automatically the intricate calculations required to accommodate these variations, the initial applicability of the program was limited largely to documentation without displayed mathematics.

A coding approach has been developed whereby displayed mathematics can now be photocomposed in place within the text using the TEXTCOMP program. Although this coding approach was developed specifically for use with TEXTCOMP and Alphanumeric's Comp-2 photocomposition system, it is applicable for use with any photocomposition system. The approach described is simple, but unconventional; the codes are demanding, but easily manageable. The most attractive aspect is that absolutely no physical measurement of characters is required.

KUDO, I.

K38 Simulation of an Ion Thruster Control System

I. Kudo (Electrotechnical Laboratory, Tokyo, Japan), L. C. Pless, and E. V. Pawlik

Technical Memorandum 33-755, February 15, 1976

This report describes the results of an initial effort at the Jet Propulsion Laboratory (JPL) to model the control loops of a 30-cm diameter electron bombardment thruster and a transistorized power processor so as to predict its operation. Data, from which the model is made, are presented as well as comparisons between the computer outputs and test data from the JPL Solar Electric Propulsion systems laboratory.

KUIPER, E. N. R.

K39 The Radio Spectrum, Electron Temperature and Ionizing Flux of the H II Region IC 5146

T. B. H. Kuiper, G. R. Knapp (California Institute of Technology), and E. N. R. Kuiper (University of California, Los Angeles)

Astron. Astrophys., Vol. 48, No. 3, pp. 475–477, May 1976

For abstract, see Kuiper, T. B. H.

KUIPER, T. B. H.

K40 Radio Observations of IC 434

T. B. H. Kuiper

Astron. Astrophys., Vol. 42, No. 3, pp. 323–327, September 1975

Continuum radio emission and hydrogen recombination line emission were measured at 2.37 GHz with the 64-m antenna at Goldstone. The radio emission has the same general distribution as the optical nebula. The radial velocity of the nebula agrees with that of the adjacent dust cloud L 1630. The electron temperature is estimated to be approximatey 8000 K. The excitation of the nebula is compared with current estimates of the ionizing flux from the exciting star, σ Orionis.

K41 The Radio Spectrum, Electron Temperature and Ionizing Flux of the H II Region IC 5146

T. B. H. Kuiper, G. R. Knapp (California Institute of Technology), and E. N. R. Kuiper (University of California, Los Angeles)

Astron. Astrophys., Vol. 48, No. 3, pp. 475–477, May 1976

We have made sensitive line and continuum observations of the small ionization-bounded H II region IC 5146, to determine its temperature and excitation parameter. The results show that the stellar Lynam continuum fluxes calculated by Panagia (1973) from non-LTE model atmospheres appear to agree most closely with our observations.

K42 Observations of Heavy-Element Recombination Lines in the Rho Ophiuchi Dark Cloud at 13 Centimeters Wavelength

G. R. Knapp (California Institute of Technology), T. B. H. Kuiper, and R. L. Brown (National Radio Astronomy Observatory)

Astrophys. J., Vol. 206, No. 1, pp. 109–113, May 15, 1976

For abstract, see Knapp, G. R.

K43 CO Observations of the Expanding Envelope of IRC + 10216

T. B. H. Kuiper, G. R. Knapp (California Institute of Technology), S. L. Knapp (California Institute of Technology), and R. L. Brown (National Radio Astronomy Observatory)

Astrophys. J., Vol. 204, No. 2, pp. 408–414, March 1, 1976

High-sensitivity emission profiles were observed from the $J = 0 - 1$ transitions of $^{12}C^{16}O$ and $^{13}C^{16}O$ toward IRC + 10216. It appears that the spherically symmetric uniform mass-outflow model proposed by Morris (1975) is necessary to describe the line profiles. The outflow appears to be slightly accelerated, having a velocity of 15 km s^{-1} at the edges of the CO cloud, compared with 12 km s^{-1} for the more centrally confined molecules.

KUMAR, R. N.

K44 Further Experimental Results on the Structure and Acoustics of Turbulent Jet Flames

R. N. Kumar (California Institute of Technology)

Aeroacoustics: Jet Noise, Combustion and Core Engine Noise (*Progr. Astronaut. Aeronaut.*, Vol. 43), pp. 483–507, 1976

The structure of open turbulent jet flames is studied experimentally in the context of their noise emission characteristics. The differences between premixed and (coflow) nonpremixed flames are explored. Recent experiments repeated in an anechoic chamber complement earlier results obtained in a hard-walled bay. The reactants (methane and enriched air) are burned in the premixed, or nonpremixed, mode after a length of pipe flow ($l/D < 150$). The thick-walled tubes anchor the flames to the tip at all of the velocities employed (maximum velocity, well over 300 fps), thus eliminating uncertainties associated with external flameholders. The time-averaged appearance of the flames is obtained with still photographs (1/60 s). The detailed structures are revealed through high-speed (≈2500 frames/s) motion pictures. The acoustic outputs of the flames are mapped with a condenser microphone. The recorded data are played back to obtain the amplitude, waveshapes, directionalities, and frequency spectra of the noise. Profound differences are found between the premixed and nonpremixed flames in their structures and noise characteristics. The premixed flame noise power scales with the third power (2.7 in an anechoic chamber), and the nonpremixed flame noise power scales with the fourth power of the mean flow velocity. The premixed flame appears to be well represented by the wrinkled flame sheet concept while discrete combustion zones (blobs) are clearly revealed in the nonpremixed case.

KUMAR, S.

K45 Mercury's Atmosphere: A Perspective after Mariner 10

S. Kumar

Icarus, Vol. 28, No. 4, pp. 579–591, August 1976

Measurements made during the Mariner 10 flybys of Mercury have shown that this planet has a tenuous atmosphere, somewhat similar to that of the Moon, which

consists of at least helium and can be classified as an exosphere. The amount of helium observed can be supplied by either the accretion of only a fraction of the solar wind He^{2+} diffusing across the magnetopause, or from outgassing of the radiogenic helium from the planetary crust. The role of solar wind in the maintenance and depletion of Mercury's atmosphere is discussed in view of the density upper limits established from Mariner 10. The argon supply rate on Mercury is probably not more than that on the Earth, but it is difficult to say whether Mercury is deficient in potassium or not on the basis of the present data. The global outgassing of CO_2 and H_2O from the planet interior is estimated to be at least four orders of magnitude smaller than for Earth which indicates that either Mercury is deficient in volatiles or that this planet is very inactive.

KUNZI, K. F.

K46 Microwave Remote Sensing of Atmospheric Temperatures From the Nimbus 5 Satellite

J. W. Waters, D. H. Staelin (Massachusetts Institute of Technology), K. F. Kunzi (Massachusetts Institute of Technology), R. L. Pettyjohn (Massachusetts Institute of Technology), and R. K. L. Poon (Massachusetts Institute of Technology)

Space Research XV, pp. 117–121, Akademie-Verlag, Berlin, 1975

For abstract, see Waters, J. W.

KUO, T. J.

K47 Ionizational Nonequilibrium Heating During Outer Planetary Entries

L. P. Leibowitz and T. J. Kuo

AIAA J., Vol. 14, No. 9, pp. 1324–1329, September 1976

For abstract, see Leibowitz, L. P.

LANDAUER, F. P.

L01 The Viking Orbiter Visual Imaging Subsystem

J. B. Wellman, F. P. Landauer, D. D. Norris, and T. E. Thorpe

Preprint 76-124, AIAA Fourteenth Aerospace Sciences Meeting, Washington, D. C., January 26–28, 1976

For abstract, see Wellman, J. B.

LANDEL, R. F.

L02 An Experimental Method to Obtain the Elastic Strain Energy Function From Torsion-Tension Tests

S. T. J. Peng and R. F. Landel

Jap. J. Appl. Phys., Vol. 15, No. 5, pp. 791–795, May 1976

For abstract, see Peng, S. T. J.

L03 Preliminary Investigation of Elongational Flow of Dilute Polymer Solutions

S. T. J. Peng and R. F. Landel

J. Appl. Phys., Vol. 47, No. 10, pp. 4255–4260, October 1976

For abstract, see Peng, S. T. J.

L04 The Tearing Test as a Means for Estimating the Ultimate Properties of Rubber

J. Glucklich and R. F. Landel

J. Appl. Polym. Sci., Vol. 20, No. 1, pp. 121–137, January 1976

For abstract, see Glucklich, J.

L05 A Generalization of the Boltzmann Superposition Principle to Polymer Networks Undergoing Scission

J. Moacanin, J. J. Aklonis, and R. F. Landel

J. Chem. Phys., Vol. 64, No. 1, p. 430, January 1, 1976

For abstract, see Moacanin, J.

L06 Viscoelastic Behavior of Elastomers Undergoing Scission Reactions

J. Moacanin, J. J. Aklonis, and R. F. Landel

J. Macromol. Sci.—Phys., Vol. B11, No. 1, pp. 41–55, 1975

For abstract, see Moacanin, J.

LANDINI, A. J.

L07 LUMIS Interactive Graphics Operating Instructions and System Specifications

N. A. Bryant, T. C. Yu, and A. J. Landini

Special Publication 43-31, August 15, 1976

For abstract, see Bryant, N. A.

L08 LUMIS, Land Use Management and Information Systems: Coordinate Oriented Program Documentation

N. A. Bryant, C. K. Paul, A. J. Landini, R. W. Bannister, and T. Logan

Special Publication 43-33, November 1, 1976

For abstract, see Bryant, N. A.

LANE, A. L.

L09 Mariner 9 Ultraviolet Spectrometer Experiment: Bright-Limb Observations of the Lower Atmosphere of Mars

J. M. Ajello, K. D. Pang, A. L. Lane, C. W. Hord (University of Colorado), and K. E. Simmons (University of Colorado)

J. Atmos. Sci., Vol. 33, No. 3, pp. 544–552, March 1976

For abstract, see Ajello, J. M.

LANSING, F. L.

L10 Heat Transfer Criteria of a Tubular Solar Collector—The Effect of Reversing the Flow Pattern on Collector Performance

F. L. Lansing

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 108–114, February 15, 1976

A new evacuated tubular solar collector has been selected for further investigation for the application of Goldstone energy conservation projects. This article presents briefly the exact heat transfer analysis of this two-pass-flow collector in an effort to determine the difference in performance characteristics with two different flow patterns. The results from the analysis are not only the determination of the collected heat rate and the temperature profiles at each cross section but also the prediction of the maximum attainable fluid temperature at zero flow rate in both cases.

L11 Computer Modeling of a Single-Stage Lithium Bromide/Water Absorption Refrigeration Unit

F. L. Lansing

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 247–257, April 15, 1976

Solar-assisted refrigeration systems have been proposed for application in Goldstone energy conservation projects. This article describes and analyzes the dynamic simulation and the computer modeling procedure of one of these systems, namely, a lithium bromide/water absorption refrigeration system. A new analytical expression that fits the three-dimensional surface of LiBr concentration, refrigerant temperature and solution temperature in the range of interest from 0.50 to 0.65 kg LiBr/kg solution is presented with a standard deviation of ±0.2 percent. This will save considerable computing time and effort required for evaluation of system performance. A numerical example from typical running conditions is added to show the relative weight of each parameter used, together with the sequence of program steps followed. The results from this simulation are heat rates, line concentrations, pressures, and the overall coefficient of performance.

L12 High Performance Flat Plate Solar Collector

F. L. Lansing and R. Reynolds

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 90–99, August 15, 1976

This article presents briefly the potential use of porous construction to achieve efficient heat removal from a power producing solid and its new application to solar air heaters. Analytical solutions are given for the temperature distribution within a gas-cooled porous flat plate having its surface exposed to the sun's energy. The extracted thermal energy is calculated for two different types of plate transparency. The results of the analysis show the great improvement in performance obtained with porous flat plate collectors as compared with analogous nonporous types.

L13 High-Efficiency Solar Concentrator

F. L. Lansing and J. Dorman

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 99–109, October 15, 1976

A new type of solar concentrator is presented using liquid lenses and simple translational tracking mechanism. The concentrator achieves a 100:1 nominal concentration ratio and is compared in performance with a flat-plate collector having two sheets of glazing and nonselective coating. The results of the thermal analysis show that higher temperatures can be obtained with the concentrator than is possible with the non-concentrator flat-plate type. Furthermore, the thermal efficiency far exceeds that of the comparative flat-plate type for all operating conditions.

L14 A Two-Dimensional Finite-Difference Solution for the Transient Thermal Behavior of a Tubular Solar Collector

F. L. Lansing

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 110–127, October 15, 1976

A numerical procedure was established using the finite-difference technique in the determination of the time-varying temperature distribution of a tubular solar collector under changing solar radiancy and ambient temperature. Three types of spatial discretization processes were considered and compared for their accuracy of computations and for selection of the shortest computer time and cost. The stability criteria of this technique was analyzed in detail to give the critical time increment to ensure stable computations. The results of the numerical analysis were in good agreement with the analytical solution previously reported. The numerical method proved to be a powerful tool in the investigation of the collector sensitivity to two different flow patterns and several flow control mechanisms.

L15 The Transient Thermal Response of a Tubular Solar Collector

F. L. Lansing

Technical Memorandum 33-781, July 15, 1976

This article is a continuation and an extension to the previous work that deals with the thermal behavior of a tubular solar collector. A special analytical solution is provided for the time-wise response of the circulating fluid temperatures when a sudden step change of the input solar radiation is imposed and remains constant thereafter. An example which demonstrates the transient temperatures at the exit section of a single collector with two different flow patterns is presented. This study is used to supplement some numerical solutions to provide a fairly complete coverage for this type of solar collector.

LaPORTE, D. D.

L16 Viking: Mars Atmospheric Water Vapor Mapping Experiment—Preliminary Report of Results

C. B. Farmer, D. W. Davies, and D. D. LaPorte (Santa Barbara Research Center)

Science, Vol. 193, No. 4255, pp. 776–780, August 27, 1976

For abstract, see Farmer, C. B.

LARSON, V.

L17 An Analytical Stochastic Controller

V. Larson

Acta Astronautica, Vol. 2, Nos. 9–10, pp. 897–899, September–October 1975

This paper addresses the problem of determining an analytical stochastic controller for achieving docking between two vehicles. With the use of simplifying assumptions, analytical RMS docking errors are determined. The analytical approach presented is considered to be a powerful preliminary design tool in assessing the effects of sensor errors and plant disturbances on docking errors.

L18 A Novel Technique for Estimating Relative Motion

V. Larson

Acta Astronautica, Vol. 2, Nos. 11/12, pp. 1031–1034, November/December 1975

This paper provides an interesting potential scheme for estimating the relative motion between two vehicles. It represents an application of modern filtering and estimation concepts.

L19 Frequency Domain Approach for Evaluation of Stochastic Control of Elastic Spacecraft

V. Larson and P. Likins

Preprint IAF-76-021, Int. Astronaut. Fed. XXVII Congress, Anaheim, Calif., Oct. 10–16, 1976

In this paper the frequency domain approach is used to evaluate a stochastic controller for an elastic spacecraft. One of the difficulties encountered in the control of elastic vehicles is how to select the modes to be retained in the Kalman filter model. A Bode analysis of the structure transfer function revealed which modes could safely be truncated from the filter model. Significant improvement in performance accompanied the use of higher-order filters resulting from the inclusion of hybrid-coordinate modes in the filter model. The use of the frequency domain greatly facilitated the problem of finding an appropriate reduced-order filter.

LAU, H. S.

L20 Atmospheric Water Vapor Calibrations: Radiometer Technique

F. B. Winn, S. C. Wu, G. M. Resch, C. C. Chao, O. H. von Roos, and H. S. Lau (Stanford University)

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 38–49, April 15, 1976

For abstract, see Winn, F. B.

LAUDENSLAGER, J. B.

L21 Electric-Discharge-Pumped Nitrogen Ion Laser

J. B. Laudenslager, T. J. Pacala, and C. Wittig, (University of Southern California)

Appl. Phys. Lett., Vol. 29, No. 9, pp. 580–582, November 1, 1976

A preionized transverse electric-discharge-pumped N_2^+ charge-transfer laser oscillating on the $(B^2\Sigma_u^+ - X^2\Sigma_g^+)$ transition of N_2^+ is reported. Peak power of 180 kW in a 8-ns FWHM laser pulse has been obtained with a 0.1% mixture of N_2 in helium at a total pressure of 3 atm. The most intense laser oscillation occurs on the (0,1) vibrational transition at 427.8 nm.

LAWSON, C. L.

L22 C^1—Compatible Interpolation Over a Triangle

C. L. Lawson

Technical Memorandum 33-770, May 1, 1976

An elementary derivation and a complete description are given of an algorithm for interpolation over a plane triangle when function values and first partial derivatives are given at the vertices. The method gives C^1 continuity with neighboring triangles. The interpolation method is mathematically equivalent to one that has been discussed previously in the literature; however, the algorithmic form given is more efficient than has been previously described.

L23 The Covariance Matrix for the Solution Vector of an Equality-Constrained Least-Squares Problem

C. L. Lawson

Technical Memorandum 33-807, December 15, 1976

Methods are given for computing the covariance matrix for the solution vector of an equality-constrained least squares problem. The methods are matched to the solution algorithms given in the book, *Solving Least Squares Problem.*

L24 Integrals of a C^1-Compatible Triangular Surface Element

C. L. Lawson

Technical Memorandum 33-808, December 15, 1976

Definite integrals are evaluated for the cardinal functions of an interpolation method which provides C^1 continuity over a triangular grid.

LAY, R.

L25 S-Band-X-Band Directional Coupler

R. Lay

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 105–107, February 15, 1976

In support of an effort to reduce microwave noise bursts at the DSN tracking stations, an S-band-X-band directional coupler has been fabricated. The goal was to develop a directional coupler that has a coupling of about 30 dB using two different rectangular waveguide sizes.

L26 X-Band Reject Filter

R. Lay

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 118–122, April 15, 1976

In support of an effort to isolate any receive band components of transmitter noise being received at the X-band maser, a one-cavity band reject filter has been fabricated and tested. The goal was to develop a series of cavity band-reject filters capable of providing a rejection of 100 dB in the passband of the receiver.

LAYLAND, J. W.

L27 Very Long Baseline Interferometry Covariance

J. W. Layland

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 21–29, February 15, 1976

This article summarizes the methods and results of a covariance calculation for determination of DSN station location and clock parameters using very long baseline interferometry (VLBI) observation of Quasars. Errors of observation are assumed to arise from random (thermal) noise at the receiving antenna, and from errors in modeling the tropospheric delay. The critical error source is seen to be the troposphere: If errors in troposphere modeling are uncorrelated between observations, then 30–50 cm station-location determinations can be obtained with current modeling accuracies; if, however, these errors are correlated, then a factor-of-ten improvement in prediction of the tropospheric delay is needed to achieve this accuracy range.

L28 Binary Sequential Ranging With Sine Waves

W. L. Martin and J. W. Layland

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 30–40, February 15, 1976

For abstract, see Martin, W. L.

L29 Threshold Analysis for VLBI Delay and Doppler

J. W. Layland

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 67–74, February 15, 1976

This article considers the problem of estimating the delay difference and doppler frequency difference for the arrival of a white noise signal from a distant Quasar at two widely separated receiving stations on Earth. The nonlinear Barankin bound is reviewed as it applies to the very long baseline interferometry (VLBI) problem, and used to evaluate the signal-to-noise ratio threshold for VLBI estimates. We conclude by comparing the performance of several sampling strategies for VLBI data.

L30 Digital Demodulation With a Non-Ideal Quantizer

J. W. Layland

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 100–105, April 15, 1976

The use of digital demodulation techniques, or the conversion from analog to digital signal domains before data are demodulated from a radio frequency (RF) carrier, has become increasingly more feasible in recent years as logic circuit speeds have increased. This feasibility has been demonstrated by use in the Dual-Channel (Mu-II) Sequential Ranging System. Further use is contemplated in the telemetry stream, or integrated into the phase-tracking receiver. This article reviews some of the properties which must be considered in the analog-to-digital (A-D) converter to be used in these applications. In particular, the loss to be expected with an A-D unit built from current circuitry is calculated.

L31 MODC2 Procedures for Assembly of MODCOMP-II Programs Using the Sigma 5 Assembler

J. W. Layland

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 47–53, August 15, 1976

This article describes a set of programs which have been written to enable the METASYMBOL assembler of the Sigma 5 to assemble programs for an attached MODCOMP-II minicomputer. This program set is a follow-on to previously developed program sets which facilitated assemblies for the PDP-11 and SDS-930.

LEBERL, F.

L32 Sequential and Simultaneous SLAR Block Adjustment

F. Leberl

Photogrammetria, Vol. 31, No. 2, pp. 39–51, August 1975

For Side Looking Airborne Radar (SLAR) mapping projects of extensive flat regions such as the Amazon basin, mosaicking procedures have been in use. In the particular case of Colombia's PRORADAM (Projecto Radargrammetrico del Amazonas), a simple sequential SLAR block adjustment produced the metric base for mosaicking. This report analyzes the relative merits of the sequential versus three methods of simultaneous adjustment of an SLAR block. It is demonstrated that sequential block formation with spline functions, followed by external interpolative adjustment, produces very good results. Simultaneous planimetric block adjustment with similarity transformations (ANBLOCK), affine transformations or transformations with spline functions cannot easily approach or surpass these results. These conclusions were obtained on the basis of controlled experiments with simulated SLAR imagery, implementing parameters of actual SLAR mapping projects.

LEIBOWITZ, L. P.

L33 Ionizational Nonequilibrium Heating During Outer Planetary Entries

L. P. Leibowitz and T. J. Kuo

AIAA J., Vol. 14, No. 9, pp. 1324–1329, September 1976

An analytical tool has been developed which enables the impact of ionizational nonequilibrium effects on outer planet entry heating to be estimated. The analysis combines recent shock-tube experiments, flowfield calculations, and planetary entry trajectory analysis. The thickness of the nonequilibrium layer and its variation around the entry body have been correlated by a reaction flow parameter over a wide range of entry conditions. The influence of nonequilibrium effects on heating during entry into Saturn and Jupiter model atmospheres has been studied and the effect of vehicle size and ballistic coefficient determined. An ionizational nonequilibrium layer of significant thickness was found to exist during portions of entry into Saturn and Jupiter warm atmospheres. However, the nonequilibrium layer was found to be thin during the peak heating portions of the trajectory and resulted in reductions in total probe heating of less than 15%.

LESH, J. R.

L34 Sequential Decoding in the Presence of a Noisy Carrier Reference

J. R. Lesh

IEEE Trans. Commun., Vol. COM-23, No. 11, pp. 1292–1297, November 1975

A new model for predicting the computational performance of a sequential decoder operating in a noisy carrier reference environment is described. The major difference between this model and previous models is that the new model characterizes the number of computations per frame as the sum of the computations resulting from a number of independent searches. This number of independent searches can then be considered as an effective frame length. When this computational model is averaged over noisy reference phase errors using a medium-rate interpolation scheme, the results are found to agree quite favorable with experimental measurements.

LEU, M. T.

L35 Rate Constants at 295 K for the Reactions of Atomic Chlorine With H_2O_2, HO_2, O_3, CH_4 and HNO_3

M. T. Leu and W. B. DeMore

Chem. Phys. Lett., Vol. 41, No. 1, pp. 121–124, July 1, 1976

The rate constants of the reactions of Cl with H_2O_2, HO_2, O_3, CH_4, and HNO_3 were measured at 295 K using a flow discharge–mass spectrometric method. The rate constants are, respectively, $(6.2 \pm 1.5) \times 10^{-13}$, $(3^{+4.5}_{-1.8}) \times 10^{-11}$, $(1.3 \pm 0.3) \times 10^{-11}$, $(1.2 \pm 0.3) \times 10^{-13}$, and $(6.8 \pm 3.4) \times 10^{-15}$ cm^3/s.

LEVITT, B. K.

L36 Power Spectrum for Binary NRZ Data With Less Than 50% Transitions

B. K. Levitt

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 86–89, April 15, 1976

Spacecraft-to-ground telemetry received by the DSN can often be modelled as binary NRZ data with independent transitions of probability $p \leq 1/2$. In this paper, a simple expression is derived for the power spectrum of this type of data modulation; this formula is used to investigate how rapidly the data bandwidth decreases as p gets smaller.

L37 Long Frame Sync Words for Binary PSK Telemetry

B. K. Levitt

IEEE Trans. Commun., Vol. COM-23, No. 11, pp. 1365–1367, November 1975

Correlation criteria have previously been established for identifying whether a given binary sequence would be a good frame sync word for phase-shift keyed telemetry. In the past, the search for a good K-bit sync word has involved the application of these criteria to the entire set of 2^K binary K-tuples. It is shown that restricting this search to a much smaller subset consisting of K-bit prefixes of pseudonoise sequences results in sync words of comparable quality, with greatly reduced computer search times for larger values of K. As an example, this procedure is used to find good sync words of length 16–63, from a storage viewpoint, each of these sequences can be generated by a 5- or 6-bit linear feedback shift register.

L38 Design Criteria for Noncoherent Gaussian Channels With MFSK Signaling and Coding

S. A. Butman, I. Bar-David (Israel Institute of Technology), B. K. Levitt, R. F. Lyon (Stanford Telecommunications, Inc.), and M. J. Klass (University of California, Berkeley)

IEEE Trans. Commun., Vol. COM-24, No. 10, pp. 1078–1088, October 1976

For abstract, see Butman, S. A.

LEVY, R.

L39 WAVEFRONT Stiffness Matrix Resequencing Program Modifications for the 1108 Computer

R. Levy

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 106–109, April 15, 1976

WAVEFRONT is a preprocessor computer program that provides a resequencing to expedite decomposition of the structural stiffness matrix within the NASTRAN analysis system. Modifications described here improve WAVEFRONT by reducing core requirements, speeding the execution, and extending the acceptable categories for input data.

L40 Conceptual Studies for New Low-Cost 64-m Antennas

R. Levy

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 55–67, June 15, 1976

Recent software developments expedite design investigations of proposed new 64-m antenna structures. The software consists of programs to generate structure model data and a design program that chooses preferential cross-sectional sizes of the structural members. Numerous new designs are summarized that can represent weight savings of from 25 to 50% with respect to the tipping weight of the existing Mars antenna. These designs provide a more favorable symmetrical support for the reflector backup and tend to provide superior surface accuracy for gravity, although not necessarily wind, loading on the antenna.

L41 Wind Power Prediction Models

R. Levy and H. McGinness

Technical Memorandum 33-802, November 15, 1976

This report describes investigations performed for the prediction of the power available from the wind at the Goldstone, California, antenna site complex. The background for power prediction is derived from a statistical evaluation of available wind speed data records at this location and at nearby locations similarly situated within the Mojave Desert. In addition to a model for power prediction over relatively long periods of time, the report describes an interim simulation model that produces sample wind speeds. The interim model furnishes uncorrelated sample speeds at hourly intervals that reproduce the statistical wind distribution at Goldstone. Beyond this, there is a discussion of a stochastic simulation model to provide speed samples representative of both the statistical speed distributions and correlations.

L42 Computer-Aided Design of Antenna Structures and Components

R. Levy

Comput. Struc., Vol. 6, Nos. 4/5, pp. 419–428, August/October 1976

This paper discusses computer-aided design procedures for antenna reflector structures and related components. The primary design aid is a computer program that establishes cross sectional sizes of the structural members by an optimality criterion. Alternative types of deflection-dependent objectives can be selected for designs subject to constraints on structure weight. The computer program has a special-purpose formulation to design structures of the type frequently used for antenna construction. These structures, in common with many in other areas of application, are represented by analytical models that employ only the three transitional degrees of freedom at each node. The special-purpose construction of the program, however, permits coding and data management simplifications that provide advantages in problem size and execution speed. Size and speed are essentially governed by the requirements of structural analysis and are relatively unaffected by the added requirements of design. Computation times to execute several design/analysis cycles are comparable to the times required by general-purpose programs for a single analysis cycle. Examples in the paper illustrate effective design improvement for structures with several thousand degrees of freedom and within reasonable computing time.

LEWICKI, G.

L43 Fixed Charge in Cr-Metallized MOS Capacitors

G. Lewicki

J. Appl. Phys.; Vol. 47, No. 4, pp. 1552–1559, April 1976

Flat-band voltages, surface-state densities, and Fowler-Nordheim tunneling characteristics were measured in MOS capacitor structures with oxide thicknesses ranging from 30 to 400 Å. The oxides were grown in dry oxygen on *p*-silicon; the metallization was gold on top of chrome. The results show the silicon-silica interface to be independent of oxide thickness down to a value of at most 40 Å. They also suggest the existence of charge not only at the silica-silicon interface but also at the metal-silica interface. The charge near the metal has the characteristic of a double layer. Right next to the interface it is negative and of magnitude 10^{19} electron charges/cm^3. It goes to zero some 75 Å into the oxide and then increases to reach a maximum positive value on the order of -10^{18} electron charges/cm^3. Approximately 150 Å into the oxide it goes to zero. The surface charge at the silicon-silica interface was as in previous investigations found to be positive and, at flat band, on the order of -3×10^{11} electron charges/cm^2.

LEWIS, J. C.

L44 Sustained Load Crack Growth Design Data for Ti-6Al-4V Titanium Alloy Tanks Containing Hydrazine

J. C. Lewis and J. T. Kenny (Martin Marietta Aerospace)

Technical Report 32-1606, September 15, 1976

Sustained load crack growth data for Ti-6Al-4V titanium alloy in hydrazine per MIL-P-26536 and refined hydrazine are presented. Fracture mechanics data on crack growth thresholds for heat-treated forgings, aged and unaged welds, and aged and unaged heat-affected zones are reported. Fracture mechanics design curves of crack

growth threshold stress intensity versus temperature are generated from 40 to 71°C.

LI, S. P.

L45 Effective Defect Density for MOS Breakdown: Dependence on Oxide Thickness

S. P. Li (California State Polytechnic University) and J. Maserjian

IEEE Trans. Electron Devices, Vol. ED-23, No. 5, pp. 525–527, May 1976

A procedure is introduced for measuring an effective density of defects that takes into account time-dependent dielectric breakdown in MOS devices. Measurements are obtained that show a surprising exponential decrease in this density with decreasing oxide thickness.

L46 Time-Dependent MOS Breakdown

S. P. Li, E. T. Bates, and J. Maserjian

Solid-State Electron., Vol. 19, No. 3, pp. 235–239, March 1976

A general model for time-dependent breakdown in metal-oxide-silicon (MOS) structures is developed and related to experimental measurements on samples deliberately contaminated with Na. A statistical method is used for measuring the breakdown probability as a function of log time and applied field. It is shown that three time regions of breakdown can be explained respectively in terms of silicon surface defects, ion emission from the metal interface, and lateral ion diffusion at the silicon interface.

LIESKE, J. H.

L47 Computer-Developed Construction of Analytic Expressions for the Coordinates and Partial Derivatives of Jupiter's Galilean Satellites

J. H. Lieske

Celest. Mech., Vol. 12, No. 1, pp. 5–17, August 1975

In his effort to develop series expressions for the coordinates of the Galilean satellites accurate to one arc second (Jovicentric), R. A. Sampson was forced *a priori* to adopt certain numerical values for several constants imbedded in his theory. His final numerical values for the series expressions are not amenable to adjustment of the constants of integration nor of physical constants which affect the motion of the satellites. A method which utilizes computer-based algebraic manipulation software has been developed to reconstruct Sampson's theory, to remove existing errors, to introduce neglected effects, and to provide analytical expressions for the coordinates as well as for the partial derivatives with respect to orbital parameters, Jupiter and satellite masses, Jupiter's oblateness, and Jupiter's pole and period of rotation. The computer-based manipulations enable one to perform, for example, the approximately 10^8 multiplications required in calculating some perturbations (and their partial derivatives) of Satellite II by Satellite III with ease, and provide algebraic expressions which can readily be adjusted to generate theories corresponding to revised constants of integration and physical parameters.

LIKINS, P.

L48 Frequency Domain Approach for Evaluation of Stochastic Control of Elastic Spacecraft

V. Larson and P. Likins

Preprint IAF-76-021, Int. Astronaut. Fed. XXVII Congress, Anaheim, Calif., Oct. 10–16, 1976

For abstract, see Larson, V.

LIN, C. L.

L49 Extinction Coefficients of Chlorine Monoxide and Chlorine Heptoxide

C. L. Lin

J. Chem. Eng. Data, Vol. 21, No. 4, pp. 411–413, October 1976

The ultraviolet and visible extinction coefficients of Cl_2O and Cl_2O_7 were measured from 180 to 800 nm. The results are comparable in shape with literature values, but different in magnitude. The approximate extinction coefficients at the peaks of infrared absorption lines are also given.

LIPES, R. G.

L50 Analysis of Command Detector Signal-to-Noise Ratio Estimator

R. G. Lipes

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 75–83, February 15, 1976

We have investigated a specific technique for making $(SNR)^{1/2}$ estimates by using in-phase channel output averages to estimate signal and quadrature channel output averages to estimate noise. We have produced bounds to determine the accuracy of this technique when fluctuations of one standard deviation occur. Our results show the estimate is relatively independent of actual input signal-to-noise ratio (SNR) and can be improved

only by increasing the number of samples in the averages.

L51 Analysis of Command Detector In-Lock Monitoring

R. G. Lipes

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 70–73, April 15, 1976

We have investigated a command detector in-lock monitoring strategy that uses N estimates of $(SNR)^{1/2}$ each composed of M samples from both data and error channel outputs. The detector recognizes only two states (in-lock and out-of-lock) and indicates state transition when N successive $(SNR)^{1/2}$ estimates violate a threshold. We give the probabilities of indicating in-lock given the detector is out-of-lock and out-of-lock given in-lock as a function of threshold for $(N,M) = (1,10)$, $(2,5)$, $(5,2)$, $(10,1)$. From these probabilities a threshold compatible with design requirements can be determined.

LIU, A. S.

L52 Spacecraft Ranging From a Ground Digitally Controlled Oscillator

A. S. Liu and G. E. Pease

J. Spacecraft Rockets, Vol. 12, No. 9, pp. 528–532, September 1975

Range measurements to the Pioneer 10 and Mariner 10 spacecraft were made, without the use of a ranging system per se, by using the Jet Propulsion Laboratory Deep Space Network's new digitally controlled oscillator (DCO) device. These measurements were accomplished by controlling the linear ramps of the transmitted carrier frequency with a recently installed DCO instrument at the Goldstone facility and analyzing the received linearly ramped Doppler data with a computer program. The accuracy of these range measurements is on the order of 1.5 km.

LIU, K. Y.

L53 The Fast Decoding of Reed–Solomon Codes Using High-Radix Fermat Theoretic Transforms

K. Y. Liu (University of Southern California), I. S. Reed (University of Southern California), and T. K. Truong

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 75–80, December 15, 1976

Fourier-like transforms over $GF(F_n)$, where $F_n = 2^{2^n} + 1$ is a Fermat prime, have found application in decoding Reed–Solomon codes. It is shown here that such transforms can be computed using high-radix fast Fourier transform (FFT) algorithms requiring considerably fewer multiplications than the more usual radix 2 FFT algorithm. A special 256-symbol, 16-symbol-error-correcting, Reed–Solomon code for space communication-link applications can be encoded and decoded using this high-radix FFT algorithm over $GF(F_5)$.

LIU, S. C.

L54 Stellar Occultation Measurements of Atmospheric Ozone and Chlorine From OAO 3

G. P. Riegler, J. F. Drake (Princeton University), S. C. Liu (University of Michigan), and R. J. Cicerone (University of Michigan)

J. Geophys. Res., Space Phys., Vol. 81, No. 28, pp. 4997–5001, October 1, 1976

For abstract, see Riegler, G. P.

LIU, S. S.

L55 Accelerated Heat-Aging Studies on Fluororubber in Various Media

S. H. Kalfayan, R. H. Silver, and S. S. Liu

Rubber Chem. Technol., Vol. 49, No. 4, pp. 1001–1009, September–October 1976

For abstract, see Kalfayan, S. H.

LIVINGSTON, F. R.

L56 Relaxation Distance and Equilibrium Electron Density Measurements in Hydrogen–Helium Plasmas

F. R. Livingston and P. T. Y. Poon

AIAA J., Vol. 14, No. 9, pp. 1335–1337, September 1976

Experimental determination of the ionization relaxation distance and electron density was made by means of holographic interferometry and spectroscopic measurements over a wide range of shock conditions (26–46 km/s at an initial pressure of 1 torr) for a realistic composition (84.17% H_2–15.83% He) simulating outer planet entry. As the shock velocity increases, the electron density increases and the relaxation distance decreases, as was expected.

LOGAN, T.

L57 LUMIS, Land Use Management and Information Systems: Coordinate Oriented Program Documentation

N. A. Bryant, C. K. Paul, A. J. Landini, R. W. Bannister, and T. Logan

Special Publication 43-33, November 1, 1976

For abstract, see Bryant, N. A.

LONG, H. R.

L58 Propellant/Material Compatibility Program and Results

L. R. Toth, W. A. Cannon, C. D. Coulbert, and H. R. Long

Technical Memorandum 33-779, August 15, 1976

For abstract, see Toth, L. R.

LONG, W. L.

L59 Impedance of Silver Oxide-Zinc Cells

H. A. Frank, W. L. Long, and A. A. Uchiyama

J. Electrochem. Soc., Vol. 123, No. 1, pp. 1–9, January 1976

For abstract, see Frank, H. A.

LORRE, J. J.

L60 Analysis of the Nebulosities Near T Tauri Using Digital Computer Image Processing

J. J. Lorre

Astrophys. J., Vol. 202, No. 3, pp. 696–717, December 15, 1975

Direct plates of T Tauri taken with the 120-inch (3 m) and 36-inch (91 cm) Lick reflectors were digitized and analyzed using digital computer image processing techniques. Luminous emission protrusions extending to as far as 13" from T Tauri in position angles 170, 210, and 330° are shown. These features are variable and may contain layered structure. The complex reflection nebula west of T Tauri (NGC 1555) appears to be an illuminated portion of a much larger dark nebula whose variability is due to obscuring material near the star.

L61 Recent Developments at JPL in the Application of Digital Image Processing Techniques to Astronomical Images

J. J. Lorre, D. J. Lynn, and W. D. Benton

Proc. SPIE Conf. Image Processing, Pacific Grove, Calif., Feb. 24–26, 1976, Vol. 74, pp. 234–238

Techniques developed for the planetary exploration program are being applied by the Image Processing Laboratory of JPL to other astronomical images. Plates of the galactic cluster Stephans Quintet were scanned and digitized. Faint nebulosity was enhanced by removing foreground stars and subjecting the resulting image to a high pass filter. Exaggerated true color images were generated by color representation of the ratios of calibrated images taken in red and blue light. Partial compensation for atmospheric degradation was accomplished with a positionally dependent convolution kernel based upon a Wiener noise-additive model. The signal to noise of the kernel was allowed to vary as a function of the local standard deviation. Photographs of Saturn were digitized and processed in an effort to obtain more information about the D-ring region. Because of the low signal level, straightforward enhancement techniques were not sufficient to bring out possible structure in this region. By transformation to a polar coordinate image, summation techniques were able to increase the apparent signal to noise of radially symmetric brightness elements. Spectra from several planets were digitized in an effort to quantify possible spectral shift as a function of position in the image. Each spectrum scan line was cross-correlated with the central scan line. From the results of this cross-correlation, a most probable spectral line tilt angle was determined.

LUACES, B. G.

L62 Viking Telecommunication Effects of GEOS Satellite Interference Based on Testing at the Madrid Deep Space Station

F. V. Stuhr, S. S. Kent, J. L. Galvez, B. G. Luaces, G. R. Pasero, and J. M. Urech

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 60–74, August 15, 1976

For abstract, see Stuhr, F. V.

LUNINE, L. R.

L63 The Procedure Writer as a Catalyst for Implementing Change

L. R. Lunine

J. Soc. Tech. Commun., Vol. 23, No. 4, pp. 10–11, 1976

The corporate procedure writer has the unenviable task of forcing change. Writing the procedure is only a small part of the job—most of it consists in interacting with those in the corporation who are governed by the procedures. The writer must know something about the personalities of the people affected by the changes. This article categorizes these personalities and explains the

tools that the procedure writer uses in performing his difficult task.

LUSHBAUGH, W. A.

L64 Standard Interface—Twin-Coaxial Converter

W. A. Lushbaugh

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 107–111, June 15, 1976

The Network Operations Control Center standard interface has been adopted as a standard computer interface for all future minicomputer-based subsystem development for the Deep Space Network. A previous article in this report series presented a discussion of an intercomputer communications link using a pair of coaxial cables. This unit is capable of transmitting and receiving digital information at distances up to 600 m with complete ground isolation between the communicating devices. This article describes a converter that allows a computer equipped with the standard interface to use the twin-coaxial link.

LYNN, D. J.

L65 Recent Developments at JPL in the Application of Digital Image Processing Techniques to Astronomical Images

J. J. Lorre, D. J. Lynn, and W. D. Benton

Proc. SPIE Conf. Image Processing, Pacific Grove, Calif., Feb. 24–26, 1976, Vol. 74, pp. 234–238

For abstract, see Lorre, J. J.

LYON, R. F.

L66 Design Criteria for Noncoherent Gaussian Channels With MFSK Signaling and Coding

S. A. Butman, I. Bar-David (Israel Institute of Technology), B. K. Levitt, R. F. Lyon (Stanford Telecommunications, Inc.), and M. J. Klass (University of California, Berkeley)

IEEE Trans. Commun., Vol. COM-24, No. 10, pp. 1078–1088, October 1976

For abstract, see Butman, S. A.

MacDORAN, P. F.

M01 A Demonstration of an Independent-Station Radio Interferometry System With 4-cm Precision on a 16-km Base Line

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, L. J. Skjerve, D. J. Spitzmesser, and H. F. Fliegel

J. Geophys. Res., Vol. 81, No. 5, pp. 995–1005, February 10, 1976

For abstract, see Thomas, J. B.

M02 A Demonstration of a Transportable Radio Interferometric Surveying System With 3-cm Accuracy on a 307-m Base Line

K. M. Ong, P. F. MacDoran, J. B. Thomas, H. F. Fliegel, L. J. Skjerve, D. J. Spitzmesser, P. D. Batelaan, S. R. Paine, and M. G. Newsted (Trend Western Engineering Corporation)

J. Geophys. Res., Vol. 81, No. 20, pp. 3587–3593, July 10, 1976

For abstract, see Ong, K. M.

MACK, L. M.

M03 A Numerical Study of the Temporal Eigenvalue Spectrum of the Blasius Boundary Layer

L. M. Mack

J. Fluid Mech., Vol. 73, Part 3, pp. 497–520, February 10, 1976

A numerical study is made of the temporal eigenvalue spectrum of the Orr–Sommerfeld equation for the Blasius boundary layer. Unlike channel flows, there is no mathematical proof that this flow has an infinite spectrum of discrete eigenvalues. The Orr–Sommerfeld equation is integrated numerically, and the eigenvalues located by tracing out the contour lines in the complex wave velocity ($c = c_r + ic_i$) plane on which the real and imaginary parts of the secular determinant are zero. This method gives only a finite and small number of discrete eigenvalues for a wide range of Reynolds numbers and wavenumbers. The spectrum of plane Poiseuille flow is used as a guide to study the spectrum of an artificial two-wall flow which consists of two Blasius boundary layers. As the upper boundary of this flow moves to infinity, it is found that the portion of the spectrum with an infinite number of eigenvalues moves towards $c_r = 1$ and the spacing between eigenvalues goes to zero. It is concluded, on the basis of this result and the contour method, that the original few eigenvalues found are the only discrete eigenvalues that exist for Blasius flow over a wide portion of the c plane for $c_r < 1$ and $c_r > 1$. It is suggested that the discrete spectrum is supplemented by a continuous spectrum which lies along the $c_r = 1$ axis for $c_i < -\alpha/R$.

MADSEN, B. D.

M04 DSN Mariner Jupiter–Saturn 1977 Prototype Radio Frequency Subsystem Compatibility Status and Test Report

A. I. Bryan and B. D. Madsen

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 4–10, October 15, 1976

For abstract, see Bryan, A. I.

M05 DSN Telemetry System Performance With Convolutionally Coded Data Using Operational Maximum-Likelihood Convolutional Decoders

B. Benjauthrit, B. D. L. Mulhall, B. D. Madsen, and M. E. Alberda

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 81–101, December 15, 1976

For abstract, see Benjauthrit, B.

MAIOCCO, F. R.

M06 Computerizing Goldstone Facility Maintenance Data for Management Decisions

F. R. Maiocco and J. P. Hume

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 310–330, April 15, 1976

This article is the result of a study done with a view to computerizing the facility maintenance management operations at the Goldstone Deep Space Communications Complex. It briefly describes the Data Management system in existence at the time the study was initiated and a proposed Automated system. Further, it gives results of development work to date, provides a few sample results, and identifies other areas of work, some of which are currently in progress or in the planning stage.

M07 An Approach to Improve Management Visibility Within the Procurement and Financial Group at Goldstone

F. R. Maiocco and J. B. Rozek

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 171–179, October 15, 1976

This article is one in a series of articles which have been written and pertains to improvements in the operational efficiency of the data management system at the Goldstone Deep Space Communications Complex (GDSCC). This particular article addresses the existing procurement and financial management data system at GDSCC, identifies management requirements for better visibility, describes a proposed computerized data management system, summarizes results to date, and identifies plans for future development.

MALIN, M. C.

M08 Observations of Intercrater Plains on Mercury

M. C. Malin

Geophys. Res. Lett., Vol. 3, No. 10, pp. 581–584, October 1976

Analysis of Mariner 10 stereoscopic images of the surface of Mercury suggests that ancient, intercrater plains consist in part of visually indistinct but topographically defined circular depressions inferred to be highly degraded craters and basins. Embayment of some craters within the heavily cratered terrain and transection of basins and craters by intercrater plains suggest that formation of at least some intercrater plains post-dates the later portions of the bombardment of Mercury by large objects. On the other hand, superposition of crater ejecta onto portions of intercrater plains in other areas indicates that some large craters formed into a pre-existing, intercrater plains unit. A single episode of obliteration (to form intercrater plains) or bombardment (to produce the large craters) cannot be reconciled with available observations. A more complex history of contemporaneous crater and plains formation is suggested.

MARGOLIS, J. S.

M09 Water Vapor Absorption of Carbon Dioxide Laser Radiation

M. S. Shumate, R. T. Menzies, J. S. Margolis, and L.-G. Rosengren

Appl. Opt., Vol. 15, No. 10, pp. 2480–2488, October 1976

For abstract, see Shumate, M. S.

M10 Measurement of Hydrogen- and Self-Broadened Half-Widths of Ammonia at 200 and 300°K

J. S. Margolis and S. Sarangi

J. Quant. Spectros. Radiat. Transfer, Vol. 16, No. 5, pp. 405–408, May 1976

The hydrogen- and self-broadened half-widths have been measured for the $(\nu_1 + \nu_2)$- and $(\nu_2 + \nu_3)$-bands of ammonia at 300 and 207°K. Measurement of hydrogen-broadened widths has been restricted to $J,K \leq 6$, but that of self-broadened widths is done for a few lines outside that range. Assuming a power-law dependence of half-

width on temperature given by $\gamma(T) = \gamma(T_0)(T/T_0)^{\alpha}$, the average value of the index α for the lines measured is found to be 0.57 for hydrogen broadening.

MARSH, E. L.

M11 Shuttle Experiment Pointing Mount (EPM) Systems

E. Mettler, E. L. Marsh, R. S. Ward, and T. Assefi

Preprint 76-964, AIAA Conf. Syst. Design Driven by Sensors, Pasadena, Calif., Oct. 18–20, 1976

For abstract, see Mettler, E.

MARSH, H. E., JR.

M12 Prediction of Crosslink Density of Solid Propellant Binders

H. E. Marsh, Jr.

Preprint 76-193, AIAA Fourteenth Aerospace Sciences Meeting, Washington, D. C., January 26–28, 1976

The general purpose of the work, of which the subject of this paper is a part, is the development of fundamental principles which will permit a comprehensive understanding and quantification of the relationships between the materials and processes and the mechanical behavior of solid propellants. Heretofore, crosslink density could be determined only after propellant formulations had been made. Relationships are described herein which provide for the calculation of the post-gelation properties, crosslink density and sol and gel fractions, in polyether-urethane propellant binders and other simple elastomers. The parameters needed are: composition, ingredient functionality distributions, and the extent of the curing reaction. A key intermediate parameter is Flory's branching coefficient, α. A specific relationship for calculating α is required for each system to account for functionality distributions, unequal reactivities, and side reactions. The post-gelation model was verified by the use of a simple ester-curing system composed of model compounds. Potential applicability of these relationships to more complex systems was demonstrated by empirical correlations between solid propellant tensile properties and calculated crosslink density.

MARTIN, K. E.

M13 Radiation Design Criteria Handbook

A. G. Stanley, K. E. Martin, and S. Douglas

Technical Memorandum 33-763, August 1, 1976

For abstract, see Stanley, A. G.

MARTIN, T. Z.

M14 Infrared Thermal Mapping of the Martian Surface and Atmosphere: First Results

H. H. Kieffer (University of California, Los Angeles), S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, F. D. Palluconi, G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and T. Z. Martin (University of California, Los Angeles)

Science, Vol. 193, No. 4255, pp. 780–786, August 27, 1976

For abstract, see Kieffer, H. H.

MARTIN, W. L.

M15 Binary Sequential Ranging With Sine Waves

W. L. Martin and J. W. Layland

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 30–40, February 15, 1976

Current ranging systems of the Deep Space Network estimate the range to a spacecraft by measuring the phase of a square-wave range code after its round trip from station to spacecraft and back. Distortion of this waveform, in the form of phase-shifts of the harmonics of the square wave, can seriously degrade ranging accuracy. This report shows that such degradation can be largely eliminated by zonal filtering the range code to only its sine-wave fundamental at no net cost in ranging signal power or accuracy.

M16 Experimental Test of General Relativity Using Time-Delay Data From Mariner 6 and Mariner 7

J. D. Anderson, P. B. Esposito, W. L. Martin, C. L. Thornton, and D. O. Muhleman (California Institute of Technology)

Astrophys. J., Vol. 200, No. 1, pp. 221–233, August 15, 1975

For abstract, see Anderson, J. D.

MASERJIAN, J.

M17 Effective Defect Density for MOS Breakdown: Dependence on Oxide Thickness

S. P. Li (California State Polytechnic University) and J. Maserjian

IEEE Trans. Electron Devices, Vol. ED-23, No. 5, pp. 525–527, May 1976

For abstract, see Li, S. P.

M18 Time-Dependent MOS Breakdown

S. P. Li, E. T. Bates, and J. Maserjian

Solid-State Electron., Vol. 19, No. 3, pp. 235–239, March 1976

For abstract, see Li, S. P.

MASSIER, P. F.

M19 Density Fluctuations and Radiated Noise for a High-Temperature Supersonic Jet

S. P. Parthasarathy, P. F. Massier, R. F. Cuffel, and J. R. Radbill

Aeroacoustics: Jet Noise, Combustion and Core Engine Noise (*Progr. Astronaut. Aeronaut.*, Vol. 43), pp. 283–305, 1976

For abstract, see Parthasarathy, S. P.

M20 Mach Wave Emission From Supersonic Jets

S. P. Parthasarathy and P. F. Massier

Preprint 76-505, AIAA Third Aero-Acoust. Conf., Palo Alto, Calif., July 20–23, 1976

For abstract, see Parthasarathy, S. P.

M21 Effects of External Boundary Layer Flow on Jet Noise in Flight

V. Sarohia and P. F. Massier

Preprint 76-558, AIAA Third Aero-Acoust. Conf., Palo Alto, Calif., July 20–23, 1976

For abstract, see Sarohia, V.

M22 Effect of Internal Temperature Fluctuations on Noise Production and Transmission of Pressure Fluctuations to the Far Field

S. P. Parthasarathy, B. Dutt, and P. F. Massier

Preprint 76-580, AIAA Third Aero-Acoust. Conf., Palo Alto, Calif., July 20–23, 1976

For abstract, see Parthasarathy, S. P.

MATSON, D. L.

M23 Io's Atmosphere and Ionosphere: New Limits on Surface Pressure From Plasma Models

T. V. Johnson, D. L. Matson, and R. W. Carlson (University of Southern California)

Geophys. Res. Lett., Vol. 3, No. 6, pp. 293–296, June 1976

For abstract, see Johnson, T. V.

M24 Photometry of 433 Eros From 0.65 to 2.2 μm

G. J. Veeder, D. L. Matson, J. T. Bergstralh, and T. V. Johnson

Icarus, Vol. 28, No. 1, pp. 79–85, May 1976

For abstract, see Veeder, G. J.

M25 Vidicon Spectral Imaging: Color Enhancement and Digital Maps

T. V. Johnson, D. L. Matson, R. J. Phillips, and R. S. Saunders

Proc. Sixth Lunar Sci. Conf. (Suppl. 6 *Geochim. Cosmochim. Acta*), pp. 2677–2688, 1975

For abstract, see Johnson, T. V.

MAXWELL, H.

M26 Graphite Fiber Reinforced Bone Cement

A. C. Knoell H. Maxwell, and C. Bechtol (Join Implant Surgery and Research Foundation, Los Angeles)

Ann. Biomed. Eng., Vol. 3, No. 2, pp. 225–229, June 1975

For abstract, see Knoell, A. C.

MAZZEO, A. A.

M27 Accelerated Heat-Aging Studies on Fluorosilicone Rubber

S. H. Kalfayan, R. H. Silver, and A. A. Mazzeo

Rubber Chem. Technol., Vol. 48, No. 5, pp. 944–952, November–December 1975

For abstract, see Kalfayan, S. H.

McELIECE, R. J.

M28 The Analysis of Structured Programs—Part I: Kirchhoff's Equations

R. J. McEliece

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 178–187, April 15, 1976

In this article we show that the analysis of a structured computer program is in some ways much easier than the analysis of an unstructured one. This is in contrast to the usual argument, which is that the synthesis of a structured program is easier than the synthesis of an unstructured one.

M29 Decoding with Multipliers

L. D. Baumert, R. J. McEliece, and G. Solomon

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 43–46, August 15, 1976

For abstract, see Baumert, L. D.

M30 An Improved Upper Bound on the Block Coding Error Exponent for Binary Input Discrete Memoryless Channels

R. J. McEliece and J. K. Omura (University of California, Los Angeles)

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 45–48, December 15, 1976

For coded telemetry systems it is important to know the tradeoff between the error probability and the complexity of implementation. For systems using block codes, the block coding error exponent is a good way to estimate this tradeoff. In this article we show how the new upper bounds on the minimum distance of binary codes obtained by McEliece et al. result in improved upper bounds on the coding error exponents for binary input memoryless channels.

M31 Zeros of Functions in Finite Abelian Group Algebras

P. Delsarte (MBLE Research Laboratory) and R. J. McEliece

Amer. J. Math., Vol. 98, No. 1, pp. 197–224, 1976

For abstract, see Delsarte, P.

McGINNESS, H.

M32 Foundation Analysis, Preliminary Investigation

H. McGinness and M. S. Katow

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 81–85, April 15, 1976

The known solution of a semi-infinite plate with normal forces on its edge is compared to the computed results of an assembly of solid finite elements in Nastran.

M33 Wind Power Prediction Models

R. Levy and H. McGinness

Technical Memorandum 33-802, November 15, 1976

For abstract, see Levy, R.

McKINLEY, E. L.

M34 Mariner Jupiter/Saturn 1977 Navigation strategy

E. L. McKinley and R. E. Van Allen

J. Spacecraft Rockets, Vol. 13, No. 8, pp. 494–501, August 1976

This paper presents selected navigational aspects of the Mariner Jupiter/Saturn 1977 mission. Emphasis is given to the trajectory correction strategy. In addition to science return and propellant costs, specific considerations affecting the strategy include a large number of candidate trajectories, relatively close satellite flybys, use of trajectory correction maneuvers for trajectory shaping, and the requirement for an optical data type to achieve precision satellite encounters. Finally, important error sources and mission constraints are identified, and their impact on the strategy is discussed.

McLYMAN, C. W. T.

M35 Simplified Cut Core Inductor Design

C. W. T. McLyman

Technical Memorandum 33-697, Rev. 1, November 1, 1976

Although filter inductor designers have routinely tended to specify moly permalloy powder cores for use in high frequency power converters and pulse-width modulated switching regulators, there are significant advantages in specifying C cores and cut toroids fabricated from grain oriented silicon steels which should not be overlooked. Such steel cores can develop flux densities of 1.6 tesla, with useful linearity to 1.2 tesla, whereas moly permalloy cores carrying dc current have useful flux density capabilities only to about 0.3 tesla. The use of silicon steel cores thus makes it possible to design more compact cores, and therefore inductors of reduced volume, or conversely to provide greater load capacity in inductors of a given volume.

For years manufacturers have rated their cores with a number that represents its relative energy-handling ability. This method assigns to each core a number that is the product of its window and core cross-section area, and is called area product A_p. The author has developed a correlation between the A_p numbers and current density J for a given temperature rise. Also, the author has developed straight-line relationships for A_p and volume, A_p and surface area A_t, and A_p and weight. These relationships can now be used as new tools to simplify and standardize the process of inductor design. They also make it possible to design inductors of small bulk and volume or to optimize efficiency.

The adoption by NASA of the metric system for dimensioning to replace the long-used English units imposes a requirement on the U. S. transformer designer to convert from the familiar units to the less familiar metric equivalents. Material is presented to assist in that transition in the field of transformer design and fabrication.

M36 Transformer Design Tradeoffs

C. W. T. McLyman

Technical Memorandum 33-767, April 1, 1976

The adoption by NASA of the metric system for dimensioning to replace the long-used English units imposes a requirement on the U.S. transformer designer to convert from the familiar unit to the less familiar metric equivalents. Material is presented to assist in this transition in the field of transformer design and fabrication.

The conversion process in power electronics requires the use of transformer components which frequently are the heaviest and bulkiest items in the conversion circuit. They also have a significant effect upon the overall performance and efficiency of the system. Accordingly, the design of such transformers has an important effect on overall system weight, power-inversion efficiency, and cost.

For years manufacturers have rated their cores with a number that represents its relative power-handling ability. This method assigns to each core a number which is the product of its window area and core cross-section area, and is called Area Product A_p.

The author has developed a coordination between the A_p numbers and current density J for a given regulation and temperature rise. The area product A_p is a dimension to the fourth power, whereas volume is a dimension to the third power and surface area A_t is a dimension to the second power. The author has developed straight-line relationships for A_p and volume, A_p and surface area A_t, and A_p and weight. These relationships can now be used as new tools to simplify and standardize the process of transformer design. They also make it possible to design transformers of small bulk and volume or to optimize efficiency.

McNAMARA, R. P.

M37 Feasibility Demonstration of a Variable Frequency Driver- Microwave Transient Regression Rate Measurement System

L. D. Strand and R. P. McNamara

Preprint 76-105, AIAA Fourteenth Aerospace Sciences Meeting, Washington, D. C., January 26–28, 1976

For abstract, see Strand, L. D.

MEEKS, W. G.

M38 Helios Mission Support

P. S. Goodwin, W. G. Meeks, R. E. Morris, and S. E. Reed

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 15–20, February 15, 1976

For abstract, see Goodwin, P. S.

M39 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 31–37, April 15, 1976

For abstract, see Goodwin, P. S.

M40 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 26–31, June 15, 1976

For abstract, see Goodwin, P. S.

M41 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 21–26, August 15, 1976

For abstract, see Goodwin, P. S.

M42 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 24–27, October 15, 1976

For abstract, see Goodwin, P. S.

M43 Tracking and Data Systems Support for the Helios Project: Project Development Through End of Mission Phase II

P. S. Goodwin, M. R. Traxler, W. G. Meeks, and F. M. Flanagan

Technical Memorandum 33-752, Vol. I, July 1, 1976

For abstract, see Goodwin, P. S.

MELNYK, J.

M44 Computer-Assisted Karyotyping

K. R. Castleman, J. Melnyk (City of Hope National Medical Center), H. J. Frieden, G. W. Persinger (City of Hope National Medical Center), and R. J. Wall

J. Reproductive Med., Vol. 17, No. 1, pp. 53–57, July 1976

For abstract, see Castleman, K. R.

MENARD, W. A.

M45 New Potentials for Conventional Aircraft When Powered by Hydrogen-Enriched Gasoline

W. A. Menard, P. I. Moynihan, and J. H. Rupe

Technical Memorandum 33-760, January 15, 1976

Hydrogen enrichment for aircraft piston engines is under study in a new NASA program. The objective of the program is to determine the feasibility of inflight injection of hydrogen in general aviation aircraft engines to reduce fuel consumption and to lower emission levels.

A catalytic hydrogen generator will be incorporated as part of the air induction system of a Lycoming turbocharged engine and will generate hydrogen by breaking down small amounts of the aviation gasoline used in the normal propulsion system. This hydrogen will then be mixed with gasoline and compressed air from the turbocharger before entering the engine combustion chamber. The special properties of the hydrogen-enriched gasoline allow the engine to operate at ultralean fuel/air ratios, resulting in higher efficiencies and hence less fuel consumption.

This paper summarizes the results of a system analysis study. Calculations assuming a Beech Duke aircraft indicate that fuel savings on the order of 20% are possible. An estimate of the potential for the utilization of hydrogen enrichment to control exhaust emissions indicates that it may be possible to meet the 1979 Federal emission standards.

M46 New Potentials for Conventional Aircraft When Powered by Hydrogen-Enriched Gasoline

W. A. Menard, P. I. Moynihan, and J H. Rupe

Paper 760469, SAE Business Aircraft Meeting, Wichita, Kansas, April 6–9, 1976

Hydrogen enrichment for aircraft piston engines is under study in a new NASA program. The objective of the program is to determine the feasibility of inflight injection of hydrogen in general aviation aircraft engines to reduce fuel consumption and to lower emission levels. A catalytic hydrogen generator will be incorporated as part of the air induction system of a Lycoming turbocharged engine and will generate hydrogen by breaking down small amounts of the aviation gasoline used in the normal propulsion system. This hydrogen will then be mixed with gasoline and compressed air from the turbocharger before entering the engine combustion chamber. The special properties of the hydrogen-enriched gasoline allow the engine to operate at ultralean fuel/air ratios, resulting in higher efficiencies and hence less fuel consumption. This paper summarizes the results of a systems analysis study. Calculations assuming a Beech Duke aircraft indicate that fuel savings on the order of 20% are possible. An estimate of the potential for the utilization of hydrogen enrichment to control exhaust emissions indicates that it may be possible to meet the 1979 Federal emission standards.

MENICHELLI, V. J.

M47 Effects of Nuclear Radiation and Elevated Temperature Storage on Electroexplosive Devices

V. J. Menichelli

J. Spacecraft Rockets, Vol. 13, No. 1, pp. 15–18, January 1976

Aerospace-type electroexplosive devices (EEDs) were subjected to nuclear radiation. Components and chemicals used in the EEDs were also included. The kind of radiation and total dosage administered were those which may be experienced in a space flight of 10 years duration, based on information available at this time. After irradiation, the items were stored in elevated constant-temperature ovens to accelerate early effects of the exposure to radiation. Periodically, samples were withdrawn for visual observation and testing. Significant changes occurred which were attributed to elevated-temperature storage and not radiation.

MENZIES, R. T.

M48 Optoacoustic Measurements of Water Vapor Absorption at Selected CO Laser Wavelengths in the 5-μm Region

R. T. Menzies and M. S. Shumate

Appl. Opt., Vol. 15, No. 9, pp. 2025–2027, September 1976

An optoacoustic detector or spectrophone has been used to perform measurements of the absorptivity of mixtures of water vapor in air. A $C^{12}O^{16}$ laser was used as the source, and measurements were made at 23 wavelengths from 5.12 to 5.32 μm. Results are presented for three different water vapor partial pressures. Comparison with previous results shows favorable agreement.

M49 Remote Measurements of Ambient Air Pollutants With a Bistatic Laser System

R. T. Menzies and M. S. Shumate

Appl. Opt., Vol. 15, No. 9, pp. 2080–2084, September 1976

The ambient air pollutants ozone, nitric oxide, and ethylene have been monitored in the Pasadena area with a bistatic ir laser apparatus. These pollutants were measured with a differential absorption technique, using selected wavelengths in the 9.5-, 5.2-, and 10.5-μm regions, respectively. The transmitted laser radiation was detected using both direct and heterodyne detection techniques. In the direct detection case, cube corner retroreflectors provided the return, and the heterodyne detection responded to scattered radiation from various rough surfaces, ranging from 400 m to 1.9 km in distance from the apparatus. Significant departures from ambient background concentration levels were noticed in the region near a local freeway during periods of moderate and heavy traffic.

M50 Water Vapor Absorption of Carbon Dioxide Laser Radiation

M. S. Shumate, R. T. Menzies, J. S. Margolis, and L.-G. Rosengren

Appl. Opt., Vol. 15, No. 10, pp. 2480–2488, October 1976

For abstract, see Shumate, M. S.

METTLER, E.

M51 Shuttle Experiment Pointing Mount (EPM) Systems

E. Mettler, E. L. Marsh, R. S. Ward, and T. Assefi

Preprint 76-964, AIAA Conf. Syst. Design Driven by Sensors, Pasadena, Calif., Oct. 18–20, 1976

Shuttle Experiment Pointing Mount System concepts and technology have been investigated and assessed with regard to payload requirements having a wide range of stability, accuracy, and control functions. Pointing systems were analyzed with end-mounted and center of gravity-mounted payloads viewing stellar and solar targets. Major error sources are identified with dynamical, stochastic, and nonlinear characteristics of structures, isolators, sensors, bearings, actuators, and controller. Results are presented which place a perspective on the potential of advanced technology to satisfy the most stringent sub-arc second pointing requirements

METZGER, A. E.

M52 Chemical Mapping of Planetary Surfaces

E. L. Haines, J. R. Arnold (University of California, San Diego), and A. E. Metzger

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 141–153, July 1976

For abstract, see Haines, E. L.

M53 Preliminary Design and Performance of an Advanced Gamma-Ray Spectrometer for Future Orbiter Missions

A. E. Metzger, R. H. Parker, J. R. Arnold (University of California, San Diego), R. C. Reedy (Los Alamos Scientific Laboratory), and J. I. Trombka (Goddard Space Flight Center)

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 2769–2784, 1975

A knowledge of the composition of planets, satellites, and asteroids is of primary importance in understanding the formation and evolution of the solar system. Gamma-ray spectroscopy is capable of measuring the composition of meter-depth surface material from orbit around any body possessing little or no atmosphere. Measurement sensitivity is determined by detector efficiency and resolution, counting time and the background flux, while the effective spatial resolution depends upon the field-of-view and counting time together with the regional contrast in composition. The advantages of using germanium as a detector of gamma rays in space are illustrated experimentally and a compact instrument cooled by passive thermal radiation is described. Calculations of the expected sensitivity of this instrument at the moon and Mars show that at least a dozen elements should be measurable, twice the number which have been isolated in the Apollo gamma-ray data.

MILES, R. F., JR.

M54 An Actual Application of Collective Choice Theory to the Selection of Trajectories for the Mariner Jupiter/Saturn 1977 Project

J. S. Dyer (University of California, Los Angeles) and R. F. Miles, Jr.

Oper. Res., Vol. 24, No. 2, pp. 220–244, March–April 1976

For abstract, see Dyer, J. S.

MILLER, R. B.

M55 Pioneer Venus 1978 Mission Support

R. B. Miller

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 11–14, February 15, 1976

The differential long baseline interferometry experiment for the purpose of measuring the wind velocities in the atmosphere of Venus as a part of the Pioneer Venus 1978 multiprobe mission is described.

M56 Pioneer Venus 1978 Mission Support

R. B. Miller

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 25–30, April 15, 1976

The DSN Master Schedule for preparations for the Pioneer Venus 1978 Orbiter and Multiprobe Mission is described.

M57 Pioneer 10 and 11 Mission Support

R. B. Miller

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 21–25, June 15, 1976

Possible improvements in the Deep Space Network and their potential effect on the telecommunications limit of Pioneer 10 and on Pioneer 11 Saturn encounter are discussed.

M58 Pioneer Venus 1978 Mission Support

R. B. Miller

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 22–27, December 15, 1976

The Tracking and Data Acquisition portion of the Ground Data System, which will support the Differential Long Baseline Interferometry Wind Measurement Experiment, is described.

MINER, E. D.

M59 Five-Color Photoelectric Photometry of Asteroid 433 Eros

E. D. Miner and J. W. Young

Icarus, Vol. 28, No. 1, pp. 43–51, May 1976

Five-color photoelectric lightcurves of asteroid 433 Eros were obtained on 9 nights during the 1974/75 apparition. Although color differences due to changing solar phase angle were detected, color differences during a single rotation of Eros are less than 1%. Amplitudes of up to 1.44 magnitudes were measured, and there are indications that three reversals in the relative depths of the two minima occurred between late December 1974 and late January 1975. The absolute visual magnitude at primary maximum, corrected to zero phase and to one AU from Earth and Sun, is about 10.8.

M60 Infrared Thermal Mapping of the Martian Surface and Atmosphere: First Results

H. H. Kieffer (University of California, Los Angeles), S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, F. D. Palluconi, G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and T. Z. Martin (University of California, Los Angeles)

Science, Vol. 193, No. 4255, pp. 780–786, August 27, 1976

For abstract, see Kieffer, H. H.

MOACANIN, J.

M61 In Vivo Degradation of Silicone Rubber Poppets in Prosthetic Heart Valves

E. F. Cuddihy, J. Moacanin, E. J. Roschke, and E. C. Harrison (University of Southern California)

J. Biomed. Mater. Res., Vol. 10, No. 3, pp. 471–481, May 1976

For abstract, see Cuddihy, E. F.

M62 A Generalization of the Boltzmann Superposition Principle to Polymer Networks Undergoing Scission

J. Moacanin, J. J. Aklonis, and R. F. Landel

J. Chem. Phys., Vol. 64, No. 1, p. 430, January 1, 1976

A method which predicts the creep and stress relaxation response of a linearly viscoelastic polymer network simultaneously undergoing viscoelastic relaxation and chain scission is used to obtain a generalization of the Boltzmann superposition principle to polymer networks undergoing these processes.

M63 Viscoelastic Behavior of Elastomers Undergoing Scission Reactions

J. Moacanin, J. J. Aklonis, and R. F. Landel

J. Macromol. Sci.—Phys., Vol. B11, No. 1, pp. 41–55, 1975

A phenomenological prediction of the creep behavior of cross-linked polymers undergoing simultaneous physical relaxation and chemical network scission is presented. The fundamental assumption underlying this calculation is defined, and its physical significance is discussed. The predicted response is related to the behavior of nonreacting polymers through a time-adjustment parameter. The magnitude and time dependence of this parameter depend on both the physical relaxation characteristics and the kinetics of the scission reaction. In the limit of totally elastic systems, a description of the well-known chemorheological behavior ensues.

MOLDAY, R. S.

M64 Functional Colloidal Particles for Immunoresearch

S. P. S. Yen, A. Rembaum, R. S. Molday (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

ACS 169th National Meeting on Emulsion Polymerization, Philadelphia, Pensylvania, April 6–11, 1975 (ACS Symposium Series, No. 24), pp. 236–257

For abstract, see Yen, S. P. S.

M65 New Immunolatex Spheres: Visual Markers of Antigens on Lymphocytes for Scanning Electron Microscopy

R. S. Molday (California Institute of Technology), W. J. Dreyer (California Institute of Technology), A. Rembaum, and S. P. S. Yen

J. Cell Biol., Vol. 64, No. 1, pp. 75–88, January 1975

New immunochemical reagents consisting of antibodies bound to small latex spheres were used as visual markers for the detection and localization of cell surface antigens by scanning electron microscopy. Cross-linked latex spheres of various sizes from 300 to 3400 angstroms in diameter were synthesized by aqueous emulsion copolymerization of methacrylate derivatives containing hydroxyl and carboxyl functional groups. Proteins and other molecules containing primary amino groups were covalently bonded to the acrylic spheres under a variety of mild conditions by the aqueous carbodiimide, cyanogen bromide, and glutaraldehyde methods. For use in the indirect immunochemical-labeling technique, goat antibodies directed against rabbit immunoglobulins were bonded to the spheres. These immunolatex reagents were shown to bind only to cells (red blood and lymphocytes) which has previously been sensitized with rabbit antibodies against cell surface antigens. Mouse spleen lymphocytes with exposed immunoglobulins on their surface (B cells) were labeled with these spheres and distinguished from unlabeled or T lymphocytes by scanning electron microscopy. The distribution of Ig receptors on lymphocytes was also studied using the spheres as visual markers. When lymphocytes were fixed with glutaraldehyde and subsequently labeled with the immunolatex reagents, a random distribution was observed by scanning electron microscopy, a patchy distribution was observed when unfixed lymphocytes were used. These results are consistent with studies using ferritin-labeled antibodies and support the view that Ig receptors on lymphocytes undergo translational diffusion. In addition to serving as visual markers for scanning electron microscopy, these latex spheres tagged with fluorescent or radioactive molecules have applications as highly sensitive markers for fluorescent microscopy and as reagents for quantitative studies of cell surface antigens and other receptors.

M66 Functional Polymeric Microspheres Based on 2-Hydroxyethyl Methacrylate for Immunochemical Studies

A. Rembaum, S. P. S. Yen, E. Cheong, S. Wallace, R. S. Molday (California Institute of Technology), I. L. Gordon (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

Macromolecules, Vol. 9, No. 2, pp. 328–336, March–April 1976

For abstract, see Rembaum, A.

M67 Latex Spheres as Markers for Studies of Cell Surface Receptors by Scanning Electron Microscopy

R. S. Molday (California Institute of Technology), W. J. Dreyer (California Institute of Technology), A. Rembaum, and S. P. S. Yen

Nature, Vol. 249, No. 5452, pp. 81–83, May 3, 1974

Latex spheres were linked to goat antibodies and used as cell surface markers for bovine red blood cells labeled with rabbit antibovine erythrocyte antiserum in scanning electron microscopy. The latex spheres were synthesized by aqueous emulsion copolymerization and contained methylmethacrylate, hydroxyethylmethacrylate, and methacrylic acid and cross linker trimethylol propane trimethacrylate. The latex spheres have diameters of 600 to 1300 angstroms, depending on conditions of polymerization.

MOORE, D. M.

M68 Five-Meter-Diameter Conical Furlable Antenna

J. W. Fortenberry, R. E. Freeland, and D. M. Moore

Technical Report 32-1604, July 15, 1976

For abstract, see Fortenberry, J. W.

MOORE, H. J.

M69 Final Report: Apollo Experiment S-217 IR/Radar Study of Apollo Data

T. W. Thompson, H. J. Moore (United States Geological Survey), G. G. Schaber (United States Geological Survey), R. W. Shorthill (University of Utah), E. A. Whitaker (University of Arizona), and S. H. Zisk (NEROC Haystack Observatory)

Technical Memorandum 33-787, October 1, 1976

For abstract, see Thompson, T. W.

MORRIS, R. E.

M70 Helios Mission Support

P. S. Goodwin, W. G. Meeks, R. E. Morris, and S. E. Reed

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 15–20, February 15, 1976

For abstract, see Goodwin, P. S.

M71 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 31–37, April 15, 1976

For abstract, see Goodwin, P. S.

M72 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 26–31, June 15, 1976

For abstract, see Goodwin, P. S.

M73 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 21–26, August 15, 1976

For abstract, see Goodwin, P. S.

M74 Helios Mission Support

P. S. Goodwin, W. G. Meeks, and R. E. Morris

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 24–27, October 15, 1976

For abstract, see Goodwin, P. S.

M75 Helios Mission Support

P. S. Goodwin, E. S. Burke, and R. E. Morris

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 28–34, December 15, 1976

For abstract, see Goodwin, P. S.

MORTON, J. B.

M76 Interpretation of Lunar Heat Flow Data

J. E. Conel and J. B. Morton

The Moon, Vol. 14, No. 2, pp. 263–289, October 1975

For abstract, see Conel, J. E.

MOYER, T. D.

M77 Transformation From Proper Time on Earth to Coordinate Time in Solar System Barycentric Space-Time Frame of Reference

T. D. Moyer

Technical Memorandum 33-786, December 1, 1976

An expression is derived for the time transformation $t - \tau$, where t is coordinate time in the solar system barycentric space-time frame of reference and τ is proper time

obtained from a fixed atomic clock on earth. This transformation is suitable for use in the computation of high-precision earth-based range and doppler observables of a spacecraft or celestial body located anywhere in the solar system; it can also be used in obtaining computed values of Very Long Baseline Interferometry data types. The formulation for computing range and doppler observables, which is an explicit function of the transformation $t - \tau$, is described briefly.

MOYNIHAN, P. I.

M78 New Potentials for Conventional Aircraft When Powered by Hydrogen-Enriched Gasoline

W. A. Menard, P. I. Moynihan, and J. H. Rupe

Technical Memorandum 33-760, January 15, 1976

For abstract, see Menard, W. A.

M79 New Potentials for Conventional Aircraft When Powered by Hydrogen-Enriched Gasoline

W. A. Menard, P. I. Moynihan, and J H. Rupe

Paper 760469, SAE Business Aircraft Meeting, Wichita, Kansas, April 6–9, 1976

For abstract, see Menard, W. A.

MOZER, F. S.

M80 Properties of ELF Electromagnetic Waves in and Above the Earth's Ionosphere Deduced From Plasma Wave Experiments on the OV1-17 and OGO 6 Satellites

M. C. Kelley (Cornell University), B. T. Tsurutani, and F. S. Mozer (University of California, Berkeley)

J. Geophys. Res., Space Phys., Vol. 80, No. 34, pp. 4603–4611, December 1, 1975

For abstract, see Kelley, M. C.

MUDGWAY, D. J.

M81 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 9–10, February 15, 1976

This article reports DSN activity in support of Viking 1 and 2 cruise operations, together with the implementation and new training directed toward completing the planetary configuration of the DSN for Viking support by 1 February 1976.

M82 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 8–20, June 15, 1976

On April 26, 1976, the Network Operations Control Center was declared available for planetary operations in support of the Viking Project. This final capability in the Network configuration for Viking had been delayed since February with hardware and software problems both in the Control Center and at the Deep Space Stations. The effect of these problems, particularly insofar as they affected production of intermediate data records, the resolution of the problems, and the current status of the Network Operations Control Center in the Viking environment, is given. Also discussed are the Operational Verification Tests performed to check out the new capabilities and associated procedures. The Viking Project tests supported by the DSN and finally the DSN support of Viking cruise operations, along with some statistics on performance, are included.

M83 Viking Mission Support

D. J. Mudgway and D. W. Johnston

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 4–20, August 15, 1976

The final operations tests prior to Mars orbit insertion for Viking I are discussed together with the real-time operations support for the two months preceding this event. The report also covers several special operational strategies and procedures designed to optimize the DSN support during the critical planetary phases of the mission. The final phases of Network implementation for Viking and the support afforded to the radio science experiments and Mars radar observations are also included.

MUELLER, P. K.

M84 Interagency Comparison of Iodometric Methods for Ozone Determination

W. B. DeMore, J. C. Romanovsky (Environmental Protection Agency), M. Feldstein (Bay Area Air Pollution Control District, San Francisco), W. J. Hamming (Los Angeles County Air Pollution Control District), and P. K. Mueller (Environmental Research and Technology, Inc.)

Calibration in Air Monitoring, ASTM STP 598, American Society for Testing and Materials, pp. 131–143, 1976

For abstract, see DeMore, W. B.

MUHLEMAN, D. O.

M85 Experimental Test of General Relativity Using Time-Delay Data From Mariner 6 and Mariner 7

J. D. Anderson, P. B. Esposito, W. L. Martin, C. L. Thornton, and D. O. Muhleman (California Institute of Technology)

Astrophys. J., Vol. 200, No. 1, pp. 221–233, August 15, 1975

For abstract, see Anderson, J. D.

MULHALL, B. D. L.

M86 Preliminary Results of DSN Performance for Convolutional Codes With a Viterbi Decoder

J. M. Urech, L. D. Vit, and B. D. L. Mulhall

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 222–240, April 15, 1976

For abstract, see Urech, J. M.

M87 DSN Telemetry System Performance With Convolutionally Coded Data Using Operational Maximum-Likelihood Convolutional Decoders

B. Benjauthrit, B. D. L. Mulhall, B. D. Madsen, and M. E. Alberda

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 81–101, December 15, 1976

For abstract, see Benjauthrit, B.

MULLER, P. M.

M88 Determination of the Cosmological Rate of Change of G and the Tidal Accelerations of Earth and Moon From Ancient and Modern Astronomical Data

P. M. Muller

Special Publication 43-36, September 15, 1976

This study undertakes to improve the theory and numerical analysis of the ancient astronomical observations (–1374 to 1715), and to combine these with the modern data in a simultaneous solution for: the tidal acceleration of the lunar longitude; the observed apparent acceleration of the earth's rotation; the true nontidal geophysical part of the earth's rotational acceleration; and the rate of change in the gravitational constant. The study provides three independent determinations of a rate of change of the gravitational constant consistent with the Hubble constant and a near-zero nontidal rotational acceleration of the earth. The tidal accelerations are shown to have remained constant during the historical period within uncertainties. Ancient and modern solar system data, and extragalactic observations provide a completely consistent astronomical and cosmological scheme.

MÜNCH, G.

M89 Infrared Thermal Mapping of the Martian Surface and Atmosphere: First Results

H. H. Kieffer (University of California, Los Angeles), S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, F. D. Palluconi, G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and T. Z. Martin (University of California, Los Angeles)

Science, Vol. 193, No. 4255, pp. 780–786, August 27, 1976

For abstract, see Kieffer, H. H.

MURPHY, A. J.

M90 Role of Thermal Contact Resistance in Pyrotechnic Ignition

V. Sernas (Rutgers University) and A. J. Murphy

J. Spacecraft Rockets, Vol. 12, No. 12, pp. 782–784, December 1975

For abstract, see Sernas, V.

MUTCH, T. A.

M91 The Geologic Development of Mars: A Review

T. A. Mutch (Brown University) and R. S. Saunders

Space Sci. Rev., Vol. 19, No. 1, pp. 3–57, June 1976

The planet Mars has been the subject of a continuing program of exploration with the flyby missions of 1964 and 1969, the orbiter of 1971, and the present Viking Project with both orbiters and landers. The overall view of Mars has changed from Earthlike in the pre-spacecraft era to Moonlike following the flyby missions and finally to a planet with intermediate characteristics. There are many impact craters as on the Moon, but tectonic and volcanic features resembling structures on Earth are also

present. However, there is a lack of evidence for the compressional deformation associated with terrestrial plate tectonics and continental drift. The current analyses indicate that Mars has a differentiated interior with a crust and mantle and perhaps a core. Whatever the nature of interior processes, whether overall mantle expansion, plumes, or full scale convection, the effects at the surface have been predominantly vertical with formation of broad regions of uplift and depression. One of the results is hemispheric asymmetry with cratered terrain in the south and younger uncratered plains in the north.

NATHAN, R.

N01 A System for the Direct Digitization of Electron Images From a TEM

R. E. Hartman, H. Alsberg, R. S. Hartman, R. Nathan, and P. Wendell

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. I, pp. 96–97

For abstract, see Hartman, R. E.

N02 Biological Atomic Resolution via Synthetic Aperture

R. Nathan

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. I, pp. 306–307

Atomic resolution of low weight atoms in biological crystals (e.g., C, N, O) has still not been accomplished through conventional application of electron microscopes. Specimen damage, spherical aberration, low contrast and noisy sensors combine to prevent direct atomic viewing. Small objective apertures (10–20 μ dia.) with their attendant diffraction limitations, but with essentially no spherical aberration, may be employed by tilting the incoming beam and specimen with respect to each other so as to obtain information relating to the higher angle spatial image components. This dark field operation is then followed by a synthetic aperture process in which a high resolution image is synthesized by a Fourier transform calculation.

N03 The Improved Stability of an Organic Crystal in the Hitachi HV-1 High Vacuum Electron Microscope

R. S. Hartman, R. E. Hartman, H. Alsberg, and R. Nathan

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. II, pp. 674–675

For abstract, see Hartman, R. S.

NEUGEBAUER, G.

N04 Infrared Thermal Mapping of the Martian Surface and Atmosphere: First Results

H. H. Kieffer (University of California, Los Angeles), S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, F. D. Palluconi, G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and T. Z. Martin (University of California, Los Angeles)

Science, Vol. 193, No. 4255, pp. 780–786, August 27, 1976

For abstract, see Kieffer, H. H.

NEUGEBAUER, M.

N05 The Role of Coulomb Collisions in Limiting Differential Flow and Temperature Differences in the Solar Wind

M. Neugebauer

J. Geophys. Res., Space Phys., Vol. 81, No. 1, pp. 78–82, January 1, 1976

Analysis of data obtained by Ogo 5 confirms the Imp 6 observations of the inverse dependence of the helium to hydrogen temperature ratio T_{He}/T_H on τ_e/τ_c, the ratio of the solar wind expansion time to the Coulomb collision equipartition time. The difference between the absolute values of the averages of T_{He}/T_H as observed by Imp and Ogo is probably due to the difference of the weights given to high- and low-velocity periods by the two experiments. The magnitude of the differential flow vector $\Delta v = |v_{He} - v_H|$ varies inversely with τ_e/τ_s (where τ_s is the Coulomb collision slowing-down time) when τ_e/τ_s is small and approaches zero when τ_e/τ_s is large. The data suggest a model of continuous preferential acceleration and heating of helium (or deceleration and cooling of hydrogen) which is opposed and limited by Coulomb collisions. Since the average dependence of Δv on τ_e/τ_s cannot explain all of the systematic variations of Δv observed in corotating high-velocity streams, extra helium acceleration (or hydrogen deceleration) probably occurs on the leading edge of such streams.

N06 Corrections to and Comments on the Paper 'The Enhancement of Solar Wind Fluctuations at the Proton Thermal Gyroradius'

M. Neugebauer

J. Geophys. Res., Space Phys., Vol. 81, No. 13, pp. 2447–2448, May 1, 1976

Corrections and comments are made on the author's paper that appeared in *J. Geophys. Res., Space Phys.*, Vol. 80, No. 7, pp. 998–1002, March 1, 1975.

N07 The Quiet Solar Wind

M. Neugebauer

J. Geophys. Res., Space Phys., Vol. 81, No. 25, pp. 4664–4670, September 1, 1976

Data from nine spacecraft are combined to study the properties of solar wind protons and the interplanetary magnetic field under the unusual conditions that proton speed, density, and temperature variations are small over periods comparable to the solar wind expansion time. From the 14 quiet intervals studied it is determined that (1) the $T^{1/2}$-v relation is less steep than was calculated from long-term-averaged or 3-hour quiet data; (2) the density varies approximately as the inverse square of the velocity; however, the data scatter is large, and an alternative interpretation is that mass flux is constant for velocities over ~400 km/s, in agreement with earlier studies; (3) the magnitude of the interplanetary magnetic field is independent of solar wind speed and density; and (4) the average field direction varies with the solar wind speed as predicted by Parker's spiral model. The intercalibration of solar wind measurements by different spacecraft is discussed in an appendix.

NEWHALL, X X

N08 JPL Development Ephemeris Number 96

E. M. Standish, Jr., M. S. W. Keesey, and X X Newhall

Technical Report 32-1603, February 29, 1976

For abstract, see Standish, E. M., Jr.

NEWSTED, M. G.

N09 A Demonstration of a Transportable Radio Interferometric Surveying System With 3-cm Accuracy on a 307-m Base Line

K. M. Ong, P. F. MacDoran, J. B. Thomas, H. F. Fliegel, L. J. Skjerve, D. J. Spitzmesser, P. D. Batelaan, S. R. Paine, and M. G. Newsted (Trend Western Engineering Corporation)

J. Geophys. Res., Vol. 81, No. 20, pp. 3587–3593, July 10, 1976

For abstract, see Ong, K. M.

NORRIS, D. D.

N10 The Viking Orbiter Visual Imaging Subsystem

J. B. Wellman, F. P. Landauer, D. D. Norris, and T. E. Thorpe

Preprint 76-124, AIAA Fourteenth Aerospace Sciences Meeting, Washington, D. C., January 26–28, 1976

For abstract, see Wellman, J. B.

N11 The Role of Fiber Optics in Mass Spectrometer Electro-Optical Ion Detection

D. D. Norris and C. E. Giffin

Proc. SPIE Conf. Fibers & Integrated Opt., Reston, Va., Mar. 22–23, 1976, Vol. 77, pp. 103–108

Today's mass spectrometers provide data to the researcher in two modes: (1) in the form of a photographic plate where line densities provide integrated ion abundances; and (2) in the form of a strip chart recording where peak intensities provide ion abundances during a mass versus time scan. Both types of data suffer from low sensitivity—the former due to the insensitivity of photographic emulsions to positive ions (10^4 ions required for a detectable line) and the latter from a low duty cycle due to spectral scanning (typically 10^{-2} –10^{-4}). This paper describes the development of an electro-optical ion detector combining the best features of photographic and electrical ion detection (i.e., wide mass range coverage and low ion detection threshold respectively). A nineteen fold fiber optic image dissector is discussed which reformats the 1 mm × 361 mm mass spectrometer focal plane format to a 19 mm × 19 mm format suitable for vidicon imaging and electronic display of the data.

NORTON, R. H.

N12 Spectroscopic Detection and Vertical Distribution of HCl in the Troposphere and Stratosphere

C. B. Farmer, O. F. Raper, and R. H. Norton

Geophys. Res. Lett., Vol. 3, No. 1, pp. 13–16, January 1976

For abstract, see Farmer, C. B.

N13 New Apodizing Functions for Fourier Spectrometry

R. H. Norton and R. Beer

J. Opt. Soc. Amer., Vol. 66, No. 3, pp. 259–264, March 1976

A new class of apodizing functions suitable for Fourier spectrometry (and similar applications) is introduced. From this class, three specific functions are discussed in

detail, and the resulting instrumental line shapes are compared to numerous others proposed for the same purpose.

O'BRIEN, V. M.

001 Landsat Follow-On: A Report by the Applications Survey Groups: Vol. I. Executive Summary

F. C. Billingsley, M. R. Helton, and V. M. O'Brien

Technical Memorandum 33-803, Vol. I, December 15, 1976

For abstract, see Billingsley, F. C.

002 Landsat Follow-On: A Report by the Applications Survey Groups: Vol. II. Discipline Discussions

F. C. Billingsley, M. R. Helton, and V. M. O'Brien

Technical Memorandum 33-803, Vol. II, December 15, 1976

For abstract, see Billingsley, F. C.

OHLSON, J. E.

003 Conical-Scan Tracking With the 64-m-diameter Antenna at Goldstone

J. E. Ohlson (Naval Postgraduate School) and M. S. Reid

Technical Report 32-1605, October 1, 1976

This report documents the theory and experimental work which demonstrated the feasibility of conical-scan tracking with the NASA/Jet Propulsion Laboratory 64-m-diameter paraboloid antenna at Goldstone, California. The purpose of this scheme is to actively track spacecraft and radio sources continuously with an accuracy superior to that obtained by manual correction of the computer-driven pointing. The conical-scan implementation gives increased tracking accuracy with X-band spacecraft signals, as demonstrated in the Mariner Venus/Mercury 1973 mission. Also, the high accuracy and ease of measurement with conical-scan tracking allow evaluation of systematic and random antenna tracking errors

004 A Correlation Polarimeter for Noise-Like Signals

J. E. Ohlson

IEEE Trans. Aerosp. Electron. Syst., Vol. AES-12, No. 2, pp. 246–254, March 1976

Optimum estimation (tracking) of the polarization plane of a linearly polarized electromagnetic wave is determined when the signal is a narrow-band Gaussian random process with a polarization plane angle which is also a Gaussian random process. This model is compared to previous work and is applicable to space communication. The estimator performs a correlation operation similar to an amplitude-comparison monopulse angle tracker, giving the name *correlation polarimeter*. Under large signal-to-noise ratio (SNR), the estimator is causal. Performance of the causal correlation polarimeter is evaluated for arbitrary SNR. Optimum precorrelation filtering is determined. With low SNR, the performance of this system is far better than that of previously developed systems Practical implementation is discussed. A scheme is given to reduce the effect of linearly polarized noise.

OHTAKAY, H.

005 Inflight Calibration Technique for Onboard High-Gain Antenna Pointing

H. Ohtakay and J. M. Hardman (Boeing Aerospace Company)

J. Spacecraft Rockets, Vol. 12, No. 12, pp. 754–759, December 1975

The X-band radio frequency communication system was used for the first time in deep space planetary exploration by the Mariner 10 Venus and Mercury flyby mission. This paper presents the technique utilized for and the results of inflight calibration of high-gain antenna (HGA) pointing. Also discussed is pointing accuracy to maintain a high data transmission rate throughout the mission, including the performance of HGA pointing during the critical period of Mercury encounter.

OMURA, J. K.

006 Foldover Effects on Viterbi Decoding

J. K. Omura and S. A. Butman

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 27–32, August 15, 1976

Viterbi decoding of X-band Mariner Venus–Mercury 1973 spacecraft data using both a hardware Viterbi decoder and a software Viterbi decoder resulted in a significant and previously unexplained difference in decoded bit error rates. This difference is explained by foldover effects which arose when the 6-bit recorded data were reduced to the required 3-bit decoded input data in the hardware Viterbi decoder.

007 An Improved Upper Bound on the Block Coding Error Exponent for Binary Input Discrete Memoryless Channels

R. J. McEliece and J. K. Omura (University of California, Los Angeles)

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 45–48, December 15, 1976

For abstract, see McEliece, R. J.

ONG, K. M.

008 A Demonstration of a Transportable Radio Interferometric Surveying System With 3-cm Accuracy on a 307-m Base Line

K. M. Ong, P. F. MacDoran, J. B. Thomas, H. F. Fliegel, L. J. Skjerve, D. J. Spitzmesser, P. D. Batelaan, S. R. Paine, and M. G. Newsted (Trend Western Engineering Corporation)

J. Geophys. Res., Vol. 81, No. 20, pp. 3587–3593, July 10, 1976

A precision geodetic measurement system (Aries for Astronomical Radio Interferometric Earth Surveying) based on the technique of a very long base line interferometry has been designed and implemented through the use of a 9-m transportable antenna and the NASA 64-m antenna of the Deep Space Communications Complex at Goldstone, California. A series of experiments designed to demonstrate the inherent accuracy of a transportable interferometer was performed on a 307-m base line during the period from December 1973 to June 1974. This short base line was chosen in order to obtain a comparison with a conventional survey with a few-centimeter accuracy and to minimize Aries errors due to transmission media effects, source locations, and earth orientation parameters. The base line vector derived from a weighted average of the measurements, representing approximately 24 h of data, possessed a formal uncertainty of about 3 cm in all components. This average interferometry base line vector was in good agreement with the conventional survey vector within the statistical range allowed by the combined uncertainties (3–4 cm) of the two techniques.

OTOSHI, T. Y.

009 Multipath Tests on 64-m Antennas Using the Viking Orbiter-1 and -2 Spacecraft as Far-Field Illuminators

T. Y. Otoshi and D. L. Brunn

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 41–49, February 15, 1976

Far-field multipath tests were performed on the 64-m antennas at Goldstone, DSS 14, and Madrid, DSS 63, by use of the transponders on the Viking Orbiter-1 and -2 spacecraft. At the time of the tests, Viking Orbiter-1 and -2 spacecraft were in their interplanetary orbits to Mars and were respectively about 21.9 million and 13.9 million km from Earth. The test results showed that the effects of multipath in the far-field of the 64-m antenna were to cause less than a 5-ns peak-to-peak variation on two-way range and 0.1-dB peak-to-peak variations on received signal level. The multipath signal level was calculated to be approximately 40 dB weaker than the primary signal in the far-field main beam direction.

010 S- X-Band Experiment: Development and Evaluation of a Set of Group Delay Standards

T. Y. Otoshi and R. W. Beatty

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 50–64, April 15, 1976

Group delay standards of 15, 30, and 60 ns have been developed at JPL with advice and consultation from the U.S. National Bureau of Standards (NBS). Calibration data on the delay standards provided by NBS and others are presented and compared. The effects of dispersion and cable reflections are discussed. Calibrations were performed at the S- X-Band Experiment frequencies of 2113, 2295, and 8415 MHz as well as at the nominal range-code modulation frequency of 500 kHz. The standards will be useful for checking out the JPL ranging system accuracy in measuring delay changes of about 15 to 60 ns.

011 Terminology of Ranging Measurements and DSS Calibrations

T. Komarek and T. Y. Otoshi

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 35–40, December 15, 1976

For abstract, see Komarek, T.

OXBORROW, G. S.

012 Preparation of Pure Microbiological Samples for Pyrolysis Gas-Liquid Chromatography Studies

G. S. Oxborrow, N. D. Fields, and J. R. Puleo

Appl. Environ. Microbiol., Vol. 32, No. 2, pp. 306–309, August 1976

Bacterial samples were prepared for pyrolysis gas-liquid chromatography using cells grown on membrane filters. Pyrochromatograms were reproducible when cells harvested from the filters were pyrolyzed without being washed.

013 Method for Collecting Naturally Occurring Airborne Bacterial Spores for Determining Their Thermal Resistance

J. R. Puleo, M. S. Favero, G. S. Oxborrow, and C. M. Herring

Appl. Microbiol., Vol. 30, No. 5, pp. 786–790, November 1975

For abstract, see Puleo, J. R.

PACALA, T. J.

P01 Electric-Discharge-Pumped Nitrogen Ion Laser

J. B. Laudenslager, T. J. Pacala, and C. Wittig (University of Southern California)

Appl. Phys. Lett., Vol. 29, No. 9, pp. 580–582, November 1, 1976

For abstract, see Laudenslager, J. B.

PAINE, S. R.

P02 A Demonstration of a Transportable Radio Interferometric Surveying System With 3-cm Accuracy on a 307-m Base Line

K. M. Ong, P. F. MacDoran, J. B. Thomas, H. F. Fliegel, L. J. Skjerve, D. J. Spitzmesser, P. D. Batelaan, S. R. Paine, and M. G. Newsted (Trend Western Engineering Corporation)

J. Geophys. Res., Vol. 81, No. 20, pp. 3587–3593, July 10, 1976

For abstract, see Ong, K. M.

PAINE, W. O.

P03 An Error-Minimizing Software Audit Technique

J. C. Holland and W. O. Paine

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 201–221, April 15, 1976

For abstract, see Holland, J. C.

PALLUCONI, F. D.

P04 Infrared Thermal Mapping of the Martian Surface and Atmosphere: First Results

H. H. Kieffer (University of California, Los Angeles), S. C. Chase, Jr. (Santa Barbara Research Center), E. D. Miner, F. D. Palluconi, G. Münch (California Institute of Technology), G. Neugebauer (California Institute of Technology), and T. Z. Martin (University of California, Los Angeles)

Science, Vol. 193, No. 4255, pp. 780–786, August 27, 1976

For abstract, see Kieffer, H. H.

PANG, K. D.

P05 Mariner 9 Ultraviolet Spectrometer Experiment: Scattering Properties of Hellas

J. M. Ajello and K. D. Pang

Icarus, Vol. 26, No. 3, pp. 332–340, November 1975

For abstract, see Ajello, J. M.

P06 Complex Refractive Index of Martian Dust: Mariner 9 Ultraviolet Observations

K. D. Pang, J. M. Ajello, C. W. Hord (University of Colorado), and W. G. Egan (Grumman Aerospace Corporation)

Icarus, Vol. 27, No. 1, pp. 55–67, January 1976

Mariner 9 ultraviolet spectra of the 1971 Mars dust storm were studied to determine the cloud particle size distribution and complex index of refraction. The method consisted of matching the observed single particle scattering albedo and phase function with Mie scattering calculations for size distributions of spheres of homogeneous and isotropic material. Preliminary results indicate that the effective particle radius is 1 μm with an effective variance (a measure of distribution width) $\gtrsim$0.2. The real component of the index of refraction is $\gtrsim$1.8 at both 268 and 305 nm. For the imaginary index, a value of 0.02 was found at 268 nm and 0.01 at 305 nm. These ultraviolet refractive indices are compatible with measurements at visible wavelengths which indicate that the real part of the refractive index is 1.75 with a negligible imaginary term. The rapid increase of refractive index and absorption coefficient with decreasing wavelength are indicative of an ultraviolet absorption band. An ultraviolet absorption band is not only diagnostic of the composition of the Mars material, but may have important implications for the development and evolution of life on Mars. A 30-μm layer of material that absorbs UV but transmits visible light can shield organisms from harmful irradiation while providing for photosynthesis. Comparison of the Mars ultraviolet refractive indices with laboratory measurements indicates that none of the terrestrial analog samples of limonite, basalt, andesite, or montmorrillonite have the required ultraviolet properties.

P07 Mariner 9 Ultraviolet Spectrometer Experiment: Bright-Limb Observations of the Lower Atmosphere of Mars

J. M. Ajello, K. D. Pang, A. L. Lane,
C. W. Hord (University of Colorado), and
K. E. Simmons (University of Colorado)

J. Atmos. Sci., Vol. 33, No. 3, pp. 544–552, March 1976

For abstract, see Ajello, J. M.

PAPAILIOU, D. D.

P08 A Proposed Concept for the Extraction of Energy Stored in Magnetic or Electric Fields in Space

D. D. Papailiou

Preprint 76-707, AIAA/SAE Twelfth Propulsion Conf. Palo Alto, Calif., July 26–29, 1976

It is known that enormous energy resources associated with electric, magnetic, gravitational, and other fields exist in space. It is also known that the major difficulty in "tapping" this energy arises from the extremely low density level at which this energy exists. An analytical study has been made of a particular scheme that appears promising for an efficient utilization of some of these energy resources in propulsion. The principle involves the exchange of energy between a fluctuating magnetic field and a velocity field of electrically conducting fluid in turbulent motion located onboard a spacecraft. Under certain conditions the total energy of the turbulent flow field onboard the spacecraft can be increased and this increase appears in the form of Joulean heat. The utilization of the fluctuating part of the magnetic field, in the form of Joulean dissipation (because of its random character) does not introduce any drag on the spacecraft. The application appears promising for flights in the vicinity of Jupiter and other planets. The rate at which energy is gained by the conducting fluid is of the order of 100 watts when the rms value of the fluctuating magnetic field strength is about 1 gauss.

PARKER, R. H.

P09 Preliminary Design and Performance of an Advanced Gamma-Ray Spectrometer for Future Orbiter Missions

A. E. Metzger, R. H. Parker,
J. R. Arnold (University of California, San Diego),
R. C. Reedy (Los Alamos Scientific Laboratory),
and J. I. Trombka (Goddard Space Flight Center)

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 2769–2784, 1975

For abstract, see Metzger, A. E.

PARTHASARATHY, S. P.

P10 An Experimental Investigation of Fluid Flow and Heating in Various Resonance Tube Modes

V. Sarohia, L. H. Back, E. J. Roschke, and
S. P. Parthasarathy

Technical Memorandum 33-780, September 1, 1976

For abstract, see Sarohia, V.

P11 Density Fluctuations and Radiated Noise for a High-Temperature Supersonic Jet

S. P. Parthasarathy, P. F. Massier,
R. F. Cuffel, and J. R. Radbill

Aeroacoustics: Jet Noise, Combustion and Core Engine Noise (*Progr. Astronaut. Aeronaut.*, Vol. 43), pp. 283–305, 1976

Experimental data on density fluctuations were obtained by the laser Schlieren method in a supersonic jet which at the nozzle exit had a Mach number of 1.43 and a stagnation temperature of about 1090 K. The jet emerged into the ambient atmosphere in an anechoic chamber, correctly expanded from a nozzle that had an exit diameter of 10.8 cm. Using the information on the density fluctuations and the mean shear obtained by probes, the autocorrelation of the radiated noise was calculated by a theory that is suitable for Mach wave emission. This theory is a modification of that developed by Ffowsc-Williams and Maidanik. The calculated noise field agrees well with that obtained by using microphones outside the jet.

P12 Mach Wave Emission From Supersonic Jets

S. P. Parthasarathy and P. F. Massier

Preprint 76-505, AIAA Third Aero-Acoust. Conf., Palo Alto, Calif., July 20–23, 1976

An experimental investigation has been conducted on supersonic jets at a Mach number of 1.43 over a temperature range from about 420 K to 1370 K (300°F to 2000°F) in which it was found that the noise in the far field was dominated by eddy Mach waves. It is shown both from experimental and theoretical considerations that the strength of the Mach waves is determined by the product of the mean shear and the density fluctuations of the jet. Thus, the source of sound arises from the mixing of hot and cold streams as well as from those compressions and expansions that are intuitively associated with sound generation. For the temperature range investigated, the Mach waves were emitted at angles between 37 deg and 59 deg with respect to the jet axis with the smaller angle occurring at the lower temperature, which is also at the lower jet velocity. These values represent those in the region of the jet where the Mach angle was

constant, that is, beginning at the nozzle exit and extending downstream to a distance ranging from 6 to 12 jet diameters, depending on temperature.

P13 Effect of Internal Temperature Fluctuations on Noise Production and Transmission of Pressure Fluctuations to the Far Field

S. P. Parthasarathy, B. Dutt, and P. F. Massier

Preprint 76-580, AIAA Third Aero-Acoust. Conf., Palo Alto, Calif., July 20–23, 1976

Experimental investigations were conducted on the transmission of pressure fluctuations and independently on the transmission of temperature fluctuations from a plenum through the exit of a nozzle to the surrounding atmosphere. The exit diameter of the nozzle was 4.2 cm. Experiments were conducted for discrete frequency inputs of both pressure and temperature fluctuations from 100 Hz to 5000 Hz and for an exit Mach number of 0.56. From the experiments, it was found that there was a direct proportionality between the generated pressure fluctuations and those sensed in the far field. Thus, there was no nonlinear amplification mechanism in the jet involved in the transmission. The far-field directivity pattern showed lobes for frequencies as low as 300 Hz, heretofore unobserved.

The transmission functions for both pressure and temperature fluctuations showed a number of peaks and valleys with differences of as much as 40 dB. However, the nondimensionalized sound pressure level for the two methods of generating fluctuations at a given Mach number of 0.56 showed that below 1000 Hz the sound pressure level in the far field was higher for the temperature fluctuations than for the pressure fluctuations.

Based on the present investigation a model for the transmission of internal temperature and pressure fluctuations through a jet is proposed. In this model the jet is considered to be a "leaky trumpet," part of the sound leaking from the sides as the wave is guided inside the jet and part escaping from the end at a downstream location where the jet velocity is so low that it is almost indistinguishable from the ambient static atmosphere. The portion of the sound leaking from the sides along the jet may be approximated by a representation of a one-dimensional antenna for which the sound moves at a velocity equal to the sum of the flow velocity and the speed of sound.

PASERO, G. R.

P14 Viking Telecommunication Effects of GEOS Satellite Interference Based on Testing at the Madrid Deep Space Station

F. V. Stuhr, S. S. Kent, J. L. Galvez, B. G. Luaces, G. R. Pasero, and J. M. Urech

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 60–74, August 15, 1976

For abstract, see Stuhr, F. V.

PATAPOFF, M.

P15 Comparison of Ozone Determinations by Ultraviolet Photometry and Gas-Phase Titration

W. B. DeMore and M. Patapoff

Environ. Sci. Technol., Vol. 10, No. 9, pp. 897–899, September 1976

For abstract, see DeMore, W. B.

PAUL, C. K.

P16 LUMIS, Land Use Management and Information Systems: Coordinate Oriented Program Documentation

N. A. Bryant, C. K. Paul, A. J. Landini, R. W. Bannister, and T. Logan

Special Publication 43-33, November 1, 1976

For abstract, see Bryant, N. A.

PAUL, F. A.

P17 A Study of Mariner 10 Flight Experiences and Some Flight Piece Part Failure Rate Computations

F. A. Paul

Technical Memorandum 33-759, January 15, 1976

Mariner 10, which derived its design pedigree from the JPL Mariner series, was highly successful and contributed significant data toward the understanding of our solar system. The success of the mission with regards to a long-term space environment allows further data to be added to our reservoir of knowledge about the behavior of electronic equipment in space. This report discusses the problems and failures encountered in flight and summarizes the data available through a quantitative accounting of all electronic piece parts on the spacecraft. It also shows computed failure rates for electronic piece parts. It is intended that these computed data be used in the continued updating of the failure rate base used for trade-off studies and predictions for future JPL space missions.

PAUL, G. M.

P18 Interplanetary Spacecraft Design Using Solar Electric Propulsion

J. H. Duxbury and G. M. Paul

J. Spacecraft Rockets, Vol. 13, No. 2, pp. 99–105, February 1976

For abstract, see Duxbury, J. H.

PAWLIK, E. V.

P19 Simulation of an Ion Thruster Control System

I. Kudo (Electrotechnical Laboratory, Tokyo, Japan), L. C. Pless, and E. V. Pawlik

Technical Memorandum 33-755, February 15, 1976

For abstract, see Kudo, I.

PEASE, G. E.

P20 LS 44—An Improved Deep Space Network Station Location Set for Viking Navigation

H. M. Koble, G. E. Pease, and K. W. Yip

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 79–98, October 15, 1976

For abstract, see Koble, H. M.

P21 Spacecraft Ranging From a Ground Digitally Controlled Oscillator

A. S. Liu and G. E. Pease

J. Spacecraft Rockets, Vol. 12, No. 9, pp. 528–532, September 1975

For abstract, see Liu, A. S.

PENG, S. T. J.

P22 An Experimental Method to Obtain the Elastic Strain Energy Function From Torsion-Tension Tests

S. T. J. Peng and R. F. Landel

Jap. J. Appl. Phys., Vol. 15, No. 5, pp. 791–795, May 1976

It has been observed by many authors that the rate of change of the strain energy function W with respect to two principal strain invariants, I_1 and I_2, is rapid near the origin; moreover, the mapping area of the strain invariants with I_1-3 and I_2-3 as coordinates is extremely small near the origin. It is found that by employing a torsion-tension test, one can have a complete and meaningful mapping near the origin. However, the mathematical representations of the twist moment M and normal force N vs. strain and strain energy function are complex. To circumvent this difficulty we propose the use of a set of solid cylindrical bars with different diameters, such that the difference in diameter of two successive bars is small. By considering differences in M or N as a function of difference in radius, at appropriate deformations (stretch and twist) selected such that I_1 or I_2 is held fixed, one can grossly simplify the stress-strain equations, to the point that one has a new way to investigate material response.

P23 Preliminary Investigation of Elongational Flow of Dilute Polymer Solutions

S. T. J. Peng and R. F. Landel

J. Appl. Phys., Vol. 47, No. 10, pp. 4255–4260, October 1976

A tubeless siphon apparatus has been set up to measure extensional flow. In this apparatus the liquid is continuously drawn into a capillary and, after steady flow has been established, the tube is raised above the liquid surface. With viscoelastic liquids the flow continues and a column can be lifted from the reservoir. At the capillary entrance an oscillating bead of excess liquid collects, which interferes both with the flow and the measurements. This can be minimized by careful control of the liquid column height. For homogeneous solutions the column is symmetrical and tapers steadily from the liquid surface to the capillary entrance, with no bulging. Preliminary results show tensile viscosities 10^3 times that of the Trouton coefficient $3\eta_{S0}$, where η_{S0} is the zero-shear-rate shear viscosity, and having a very strong dependence on deformation rate. A concentration-stretch rate-reduced variable scheme is proposed.

PERSINGER, G. W.

P24 Computer-Assisted Karyotyping

K. R. Castleman, J. Melnyk (City of Hope National Medical Center), H. J. Frieden, G. W. Persinger (City of Hope National Medical Center), and R. J. Wall

J. Reproductive Med., Vol. 17, No. 1, pp. 53–57, July 1976

For abstract, see Castleman, K. R.

PETTYJOHN, R. L.

P25 Microwave Remote Sensing of Atmospheric Temperatures From the Nimbus 5 Satellite

J. W. Waters, D. H. Staelin (Massachusetts Institute of Technology), K. F. Kunzi (Massachusetts Institute of Technology), R. L. Pettyjohn (Massachusetts Institute of Technology), and R. K. L. Poon (Massachusetts Institute of Technology)

Space Research XV, pp. 117–121, Akademie-Verlag, Berlin, 1975

For abstract, see Waters, J. W.

PHILLIPS, H. P.

P26 Magnitude of 64-m Elevation Axis Movements Due to Alidade Temperature Changes

N. T. Hung, H. P. Phillips, and R. A. Zanteson

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 41–44, December 15, 1976

For abstract, see Hung, N. T.

PHILLIPS, K.

P27 Aspects of Job Scheduling

K. Phillips

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 129–140, August 15, 1976

A mathematical model for job scheduling in a specified context is presented. The model uses both linear programming and combinatorial methods. While designed with a view toward optimization of scheduling of facility and plant operations at the Deep Space Communications Complex at Goldstone, the context is sufficiently general to be widely applicable. The general scheduling problem including options for scheduling objectives is discussed and fundamental parameters identified. Mathematical algorithms for partitioning problems germane to scheduling are presented: A more detailed description of algorithms and of operational aspects of the model is planned for a later report.

PHILLIPS, R. J.

P28 Magnetic Permeability Measurements and a Lunar Core

B. E. Goldstein, R. J. Phillips, and C. T. Russell (University of California, Los Angeles)

Geophys. Res. Lett., Vol. 3, No. 6, pp. 289–292, June 1976

For abstract, see Goldstein, B. E.

P29 Gravity Fields

W. L. Sjogren, J. D. Anderson, R. J. Phillips, and D. W. Trask

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 172–183, July 1976

For abstract, see Sjogren, W. L.

P30 Vidicon Spectral Imaging: Color Enhancement and Digital Maps

T. V. Johnson, D. L. Matson, R. J. Phillips, and R. S. Saunders

Proc. Sixth Lunar Sci. Conf. (Suppl. 6 *Geochim. Cosmochim. Acta*), pp. 2677–2688, 1975

For abstract, see Johnson, T. V.

PHILLIPS, W. M.

P31 System Design for a Nuclear Electric Spacecraft Utilizing Out-of-Core Thermionic Conversion

W. C. Estabrook, W. M. Phillips, and T. Hsieh

Technical Memorandum 33-791, September 1, 1976

For abstract, see Estabrook, W. C.

PIERCE, D. A.

P32 Observations of Saturn's Satellites 1789–1972

D. A. Pierce

Pub. Astron. Soc. Pacific, Vol. 87, No. 519, pp. 785–787, October 1975

A data-collection and literature search has yielded over 22,000 observations of the known satellites of Saturn, made from 1789 through 1972. The type (photographic, micrometer, etc.) and number of observations are tabulated in ten-year increments, and a complete bibliography is referenced.

PLESS, L. C.

P33 Simulation of an Ion Thruster Control System

I. Kudo (Electrotechnical Laboratory, Tokyo, Japan), L. C. Pless, and E. V. Pawlik

Technical Memorandum 33-755, February 15, 1976

For abstract, see Kudo, I.

POON, P. T. Y.

P34 Relaxation Distance and Equilibrium Electron Density Measurements in Hydrogen–Helium Plasmas

F. R. Livingston and P. T. Y. Poon

AIAA J., Vol. 14, No. 9, pp. 1335–1337, September 1976

For abstract, see Livingston, F. R.

POON, R. K. L.

P35 Microwave Remote Sensing of Atmospheric Temperatures From the Nimbus 5 Satellite

J. W. Waters, D. H. Staelin (Massachusetts Institute of Technology), K. F. Kunzi (Massachusetts Institute of Technology), R. L. Pettyjohn (Massachusetts Institute of Technology), and R. K. L. Poon (Massachusetts Institute of Technology)

Space Research XV, pp. 117–121, Akademie-Verlag, Berlin, 1975

For abstract, see Waters, J. W.

POSNER, E. C.

P36 Life Cycle Costing of Long-Term Capability With a Discount Rate

E. C. Posner

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 301–309, April 15, 1976

This article studies life-cycle costing for a capability needed for the indefinite future. The two costs considered are reprocurement cost and maintenance and operations (M&O) cost. The reprocurement price is assumed known, and the M&O costs are assumed to be a known function of the time since last reprocurement, in fact an increasing function. The problem is to choose the optimum reprocurement time so as to minimize the quotient of the total cost over a reprocurement period divided by the period. Or one could assume a discount rate and try to minimize the total discounted costs into the indefinite future. It is shown that the optimum policy in the presence of a small discount rate hardly depends on the discount rate at all, and leads to essentially the same policy as in the case in which discounting is not considered. An algorithm for finding the optimum reprocurement time is presented as implemented in an MBASIC program.

P37 A Technique for Generating Correlated X-Band Weather Degradation Statistics

E. C. Posner and F. J. Zeigler

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 180–196, October 15, 1976

Flight projects relying on the DSN's X-band receiving facilities for X-band telemetry and/or tracking require some technique for generating test cases of degradations to use in mission sequence planning exercises and even in data rate selection. It is, for example, known that the X-band noise temperature of DSN receivers can go up from 20 K to over 100 K or more, if the air is heavily laden with water vapor, although that is an uncommon occurrence. It is proposed that the DSN furnish flight projects relying on X-band degradation models, one for each DSN Complex. Such models would be in the form of a random process generator, say, in an MBASIC program, that would permit the project to generate X-band degradation data with the right autocorrelations for periods of interest to the Projects. The autocorrelation modeling is especially important because bursts of degradation lasting several days can affect data storage and mission sequence design strategy. This article therefore presents one approach which works if the degradation statistics obey a half-gaussian law. That is, the random variables are formed by taking the absolute values of another set of random variables, themselves having a (two-sided) gaussian distribution. The technique of this paper then permits the half-gaussian random variables to have given one- and two-step correlation coefficients.

P38 A Model to Predict Benefits of Priority Lanes on Freeways

E. C. Posner

Transp. Sci., Vol. 10, No. 2, pp. 169–204, May 1976

An interactive computer-based model is described which permits a reasonable assessment of the decrease in the number of vehicle miles driven when one or several lanes of a freeway are devoted to the exclusive use of "carpools": vehicles carrying at least a specified number of people. The vehicle miles driven are obtained by finding the equilibrium distribution of pool sizes as a function of distance driven, on both regular and priority lanes. A simple but believable economic model incorporating the cost of time and the "utility" of having a vehicle for one's exclusive use is the basis for determining what individuals will do in their self-interest. The economic model is partly verified using existing pooling data without priority lanes. The idea of the priority lane or lanes

is, of course, that they move faster than the regular lanes. However, an attractive feature of the priority lane concept is that, in typical cases, traffic flow is actually improved even for those who choose not to pool. Simple runs of the model show that in some cases it can be better for all concerned if two lanes are reserved for carpools rather than one lane, and if vehicles with two occupants are allowed to use the priority lanes rather than requiring three occupants. A 12.5-mi stretch of the Santa Monica Freeway in the Los Angeles area is used as a computational example for the theory. Further refinements to the model are suggested.

PRESTON, R. A.

P39 ALSEP–Quasar Differential VLBI

M. A. Slade, R. A. Preston, A. W. Harris, L. J. Skjerve, and D. J. Spitzmesser

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 37–54, June 15, 1976

For abstract, see Slade, M. A.

P40 2290-MHz Flux Densities of 52 High-Declination Radio Sources

A. W. Harris, R. A. Preston, D. J. Spitzmesser, M. A. Slade, and L. J. Skjerve

Astron. J., Vol. 81, No. 4, pp. 222–224, April 1976

For abstract, see Harris, A. W.

PRICE, A. L.

P41 Temperature Effects on Transmission Line Phase and Group Delay

H. R. Buchanan and A. L. Price

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 296–300, April 15, 1976

For abstract, see Buchanan, H. R.

PRICE, W. E.

P42 Irradiate-Anneal Screening of Total Dose Effects in Semiconductor Devices

A. G. Stanley and W. E. Price

Technical Memorandum 33-788, July 15, 1976

For abstract, see Stanley, A. G.

PULEO, J. R.

P43 Preparation of Pure Microbiological Samples for Pyrolysis Gas-Liquid Chromatography Studies

G. S. Oxborrow, N. D. Fields, and J. R. Puleo

Appl. Environ. Microbiol., Vol. 32, No. 2, pp. 306–309, August 1976

For abstract, see Oxborrow, G. S.

P44 Method for Collecting Naturally Occurring Airborne Bacterial Spores for Determining Their Thermal Resistance

J. R. Puleo, M. S. Favero, G. S. Oxborrow, and C. M. Herring

Appl. Microbiol., Vol. 30, No. 5, pp. 786–790, November 1975

The ability to determine the thermal resistance of naturally occurring airborne bacterial spores associated with spacecraft and their assembly areas has been hindered by lack of an effective collecting system. Efforts to collect and concentrate spores with air samplers or from air filters have not been successful. A fallout method was developed for this purpose and tested. Sterile Teflon ribbons (7.6 by 183 cm) were exposed in pertinent spacecraft assembly areas and subsequently treated with dry heat. Thermal inactivation experiments were conducted at 125 and 113 C. Heating intervals ranged from 1 to 12 h at 125 C and 6, 12, 18, and 24 h at 113 C. Eight hours was the longest heating time yielding survivors at 125 C, whereas survivors were recovered at all of the heating intervals at 113 C. D_{125C} values were calculated using the fractional-replicate-unit-negative technique of Pflug and Schmidt (1968) and ranged from 25 to 126 min. This variation indicated that the most probable number of survivors at each heating interval did not fall on a straight line passing through the initial spore population. However, the most-probable-number values taken alone formed a straight line suggesting logarithmic thermal destruction of a subpopulation of spores with a D_{125C} value of 6.3 h.

PURCELL, G.

P45 A Procedure for Preliminary Reduction of Bandwidth Synthesis Data

G. Purcell

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 149–154, June 15, 1976

The procedure described here provides a fast, flexible, and inexpensive way to reduce and evaluate bandwidth synthesis observations before committing them to a more

complex general-purpose fitting program. It enables the user to apply various corrections to the data, to resolve integer-cycle ambiguities, to calculate preliminary values of the baseline vector and source positions, and to assess the quality of the observations.

RADBILL, J. R.

R01 Density Fluctuations and Radiated Noise for a High-Temperature Supersonic Jet

S. P. Parthasarathy, P. F. Massier, R. F. Cuffel, and J. R. Radbill

Aeroacoustics: Jet Noise, Combustion and Core Engine Noise (*Progr. Astronaut. Aeronaut.*, Vol. 43), pp. 283–305, 1976

For abstract, see Parthasarathy, S. P.

RAPER, O. F.

R02 Spectroscopic Detection and Vertical Distribution of HCl in the Troposphere and Stratosphere

C. B. Farmer, O. F. Raper, and R. H. Norton

Geophys. Res. Lett., Vol. 3, No. 1, pp. 13–16, January 1976

For abstract, see Farmer, C. B.

RAYERMANN, P.

R03 A Photoionization Mass Spectrometer Study of $CFCl_3$, CF_2Cl_2, and CF_3Cl

J. M. Ajello, W. T. Huntress, Jr., and P. Rayermann

J. Chem. Phys., Vol. 64, Vol. 11, pp. 4746–4754, June 1, 1976

For abstract, see Ajello, J. M.

RAYFIELD, M.

R04 RAPID—A Random Access Picture Digitizer, Display, and Memory System

Y. Yakimovsky, M. Rayfield, and R. Eskenazi

Technical Memorandum 33-772, May 15, 1976

For abstract, see Yakimovsky, Y.

REA, D. G.

R05 Exploring the Planets With Spacecraft—Accomplishments to Date

D. G. Rea

Proc. Twenty-Fifth Int. Astronaut. Congress, Amsterdam, Netherlands, Sept. 30–Oct. 5, 1974, pp. 309–334

The Space Age for planetary exploration began with the successful flyby of Venus by Mariner 2 in 1962. Observations from spacecraft, coupled with a steadily increasing flow of Earth-based observations, have greatly changed and refined our understanding of the planets and their satellites. The volume of data and the generation of new conclusions and posing of new questions have few parallels in the history of science. This paper gives the highlights of this new era of discovery.

REED, I. S.

R06 The Fast Decoding of Reed–Solomon Codes Using Number Theoretic Transforms

I. S. Reed (University of Southern California), L. R. Welch (University of Southern California), and T. K. Truong

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 64–78, October 15, 1976

It is shown that Reed-Solomon (RS) codes can be encoded and decoded by using a fast Fourier transform (FFT) algorithm over finite fields. A Fourier-like transform is defined over finite fields of type $I_{F_n}(\sqrt[8]{2})$, where F_n is a Fermat prime for $n \leq 4$. The field $I_{F_n}(\sqrt[8]{2})$ is used to extend the length of the original Fermat number transforms by a factor of 8. The arithmetic utilized to perform these transforms over the field of type $I_{F_n}(\sqrt[8]{2})$ requires only integer additions, circular shifts and a minimum number of integer multiplications by powers of $\sqrt[8]{2}$. The computing time of this transform encoder-decoder for RS codes is less than the time of the standard method for RS codes.

More generally, the field $GF(q)$ is also considered, where q is a prime of the form $K \times 2^n + 1$ and K and n are integers. $GF(q)$ can be used to decode very long RS codes by an efficient FFT algorithm with an improvement in the number of symbols. The arithmetic needed for these more general transforms requires only slightly modified binary integer additions and multiplications.

Transforms can be defined also over the Galois field $GF(q^2)$, a finite field analogous to the complex number field, where $q = 2^p - 1$ is a Mersenne prime. The arithmetic needed for this case requires integer complex multiplications mod q and additions mod q.

It is shown in this paper that a radix-8 FFT algorithm over $GF(q^2)$ can be utilized to encode and decode very long RS codes with a large number of symbols. For eight symbols in $GF(q^2)$, this transform over $GF(q^2)$ can be

made simpler than any other known number theoretic transform with a similar capability. Of special interest is the decoding of a 16-tuple RS code with four errors.

R07 The Fast Decoding of Reed–Solomon Codes Using Fermat Theoretic Transforms and Continued Fractions

L. R. Welch (University of Southern California), I. S. Reed (University of Southern California), and T. K. Truong

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 63–74, December 15, 1976

For abstract, see Welch, L. R.

R08 The Fast Decoding of Reed–Solomon Codes Using High-Radix Fermat Theoretic Transforms

K. Y. Liu (University of Southern California), I. S. Reed (University of Southern California), and T. K. Truong

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 75–80, December 15, 1976

For abstract, see Liu, K. Y.

REED, S. E.

R09 Helios Mission Support

P. S. Goodwin, W. G. Meeks, R. E. Morris, and S. E. Reed

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 15–20, February 15, 1976

For abstract, see Goodwin, P. S.

REEDY, R. C.

R10 Preliminary Design and Performance of an Advanced Gamma-Ray Spectrometer for Future Orbiter Missions

A. E. Metzger, R. H. Parker, J. R. Arnold (University of California, San Diego), R. C. Reedy (Los Alamos Scientific Laboratory), and J. I. Trombka (Goddard Space Flight Center)

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 2769–2784, 1975

For abstract, see Metzger, A. E.

REICHLEY, P. E.

R11 A Radar Study of the Backup Martian Landing Sites

G. S. Downs, R. R. Green, and P. E. Reichley

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 49–52, December 15, 1976

For abstract, see Downs, G. S.

R12 Radar Measurements of Martian Topography and Surface Properties: The 1971 and 1973 Oppositions

G. S. Downs, P. E. Reichley; and R. R. Green

Icarus, Vol. 26, No. 3, pp. 273–312, November 1975

For abstract, see Downs, G. S.

REID, M. S.

R13 Conical-Scan Tracking With the 64-m-diameter Antenna at Goldstone

J. E. Ohlson (Naval Postgraduate School) and M. S. Reid

Technical Report 32-1605, October 1, 1976

For abstract, see Ohlson, J. E.

R14 The Analysis of Microwave Weather Project Data

M. S. Reid

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 110–117, April 15, 1976

The Microwave Weather Project forms part of an overall Radio Systems Development Project which seeks to optimize the spacecraft-to-ground communications link. Statistical correlations of weather and communications capability at X- and K-bands are needed to provide practical statistical prediction of the performance of the Deep Space Network at X-Band and, in the future, at K-band. A previous article discussed the general approach of the project, the measurements, calibrations, equipment, and methods. This article summarizes the results of the Weather Project for 1971 through 1974. Computed results of increases in system temperature due to atmospheric effects are plotted as functions of time, frequency, elevation angle, etc. Comparisons are made with theoretical predictions derived from a contractor report submitted to JPL, which calculated signal attenuation due to cloud cover from meteorological measurements.

R15 Toward a Mathematical Model of Solar Radiation for Engineering Analysis of Solar Energy Systems

C. L. Hamilton and M. S. Reid

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 147–151, August 15, 1976

For abstract, see Hamilton, C. L.

REILLY, H. F., JR.

R16 Development of a Water Vapor Radiometer to Correct for Tropospheric Range Delay in DSN Applications

P. D. Batelaan, T. Sato, S. D. Slobin, and H. F. Reilly, Jr.

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 77–84, June 15, 1976

For abstract, see Batelaan, P. D.

REMBAUM, A.

R17 Functional Colloidal Particles for Immunoresearch

S. P. S. Yen, A. Rembaum, R. S. Molday (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

ACS 169th National Meeting on Emulsion Polymerization, Philadelphia, Pensylvania, April 6–11, 1975 (ACS Symposium Series, No. 24), pp. 236–257

For abstract, see Yen, S. P. S.

R18 New Immunolatex Spheres: Visual Markers of Antigens on Lymphocytes for Scanning Electron Microscopy

R. S. Molday (California Institute of Technology), W. J. Dreyer (California Institute of Technology), A. Rembaum, and S. P. S. Yen

J. Cell Biol., Vol. 64, No. 1, pp. 75–88, January 1975

For abstract, see Molday, R. S.

R19 Functional Polymeric Microspheres Based on 2-Hydroxyethyl Methacrylate for Immunochemical Studies

A. Rembaum, S. P. S. Yen, E. Cheong, S. Wallace, R. S. Molday (California Institute of Technology), I. L. Gordon (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

Macromolecules, Vol. 9, No. 2, pp. 328–336, March–April 1976

Co γ irradiation of 2-hydroxyethyl methacrylate in the presence or in the absence of other acrylic monomers was found to constitute an effective technique for the synthesis of hydrophilic functional microspheres in the size range of approximately 0.3 to 3 μ in diameter. The effect of monomer concentration, steric stabilization, and electrostatic interaction on the particle size was investigated. Experimental conditions were determined to obtain desired particle sizes of relatively narrow distribution. It was shown that particles may be formed without intermediate micelles, i.e., by homogeneous nucleation, and the rate of particle formation is affected primarily by the rate of particle coalescence in the initial stages of the reaction. When covalently bound to antibodies, these microspheres were successfully used to label murine and human lymphocytes.

R20 Latex Spheres as Markers for Studies of Cell Surface Receptors by Scanning Electron Microscopy

R. S. Molday (California Institute of Technology), W. J. Dreyer (California Institute of Technology), A. Rembaum, and S. P. S. Yen

Nature, Vol. 249, No. 5452, pp. 81–83, May 3, 1974

For abstract, see Molday, R. S.

RENNINGER, G. M.

R21 Bactericidal Effect of Hydrogen Peroxide on Spacecraft Isolates

M. D. Wardle and G. M. Renninger (Bionetics Corporation)

Appl. Microbiol., Vol. 30, No. 4, pp. 710–711, October 1975

For abstract, see Wardle, M. D.

RENZETTI, N. A.

R22 DSN Functions and Facilities

N. A. Renzetti

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 1–4, February 15, 1976

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objec-

tives, functions, and organization of the DSN are summarized, and the Deep Space Stations, the Ground Communications Facility, and the Network Control System are described.

R23 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 1–3, April 15, 1976

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the Deep Space Stations, the Ground Commnications Facility, and the Network Control System are described.

R24 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 1–3, June 15, 1976

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the Deep Space Stations, the Ground Communications Facility, and the Network Control System are described.

R25 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 1–3, August 15, 1976

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the Deep Space Stations, the Ground Communications Facility, and the Network Control System are described.

R26 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 1–3, October 15, 1976

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the deep space stations, the Ground Communications Facility, and the Network Control System are described.

R27 Network Functions and Facilities

N. A. Renzetti

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 1–3, December 15, 1976

The Deep Space Network (DSN), established by the NASA Office of Tracking and Data Acquisition and under the system management and technical direction of JPL, is designed for two-way communications with unmanned spacecraft traveling approximately 16,000 km (10,000 mi) from Earth to planetary distances. The objectives, functions, and organization of the DSN are summarized, and the deep space stations, the Ground Communications Facility, and the Network Control System are described.

RESCH, G. M.

R28 Atmospheric Water Vapor Calibrations: Radiometer Technique

F. B. Winn, S. C. Wu, G. M. Resch, C. C. Chao, O. H. von Roos, and H. S. Lau (Stanford University)

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 38–49, April 15, 1976

For abstract, see Winn, F. B.

REYNOLDS, R.

R29 High Performance Flat Plate Solar Collector

F. L. Lansing and R. Reynolds

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 90–99, August 15, 1976

For abstract, see Lansing, F. L.

RHIM, W. K.

R30 Extraction of Quadrature Phase Information From Multiple Pulse NMR Signals

W. K. Rhim, D. P. Burum (California Institute of Technology), and R. W. Vaughan (California Institute of Technology)

Rev. Sci. Instrum., Vol. 47, No. 6, pp. 720–725, June 1976

A multiple pulse sequence (8-pulse sequence) used for high-resolution solid state NMR is analyzed with regard to the information available from each of the four wide sampling windows. It is demonstrated that full quadrature phase information can be obtained using only a single phase detector and that, for the commonly encountered situation where the spectral width is much less than the folding frequency, the signals from the various windows can be combined easily using standard complex Fourier transform software. An improvement in the signal-to-noise-ratio of $3^{1/2}$ is obtained over either standard single or quadrature phase detection schemes. Procedures for correcting spectral distortions are presented.

RHOADS, J. W.

R31 A Reduced Star Catalog Containing 5116 Designated Stars

J. W. Rhoads

Technical Memorandum 33-758, January 15, 1976

This document is the second in a series of publications presenting data, compiled by JPL, which is to be included in the JPL Astronautical Star Catalog. Positional and color magnitude data for the 5116 designated stars, which are to be included in the catalog, are given.

RHODES, E. J., JR.

R32 Evidence of a Large-Scale Gradient in the Solar Wind Velocity

E. J. Rhodes, Jr. and E. J. Smith

J. Geophys. Res., Space Phys., Vol. 81, No. 13, pp. 2123–2134, May 1, 1976

Measurements of the solar wind velocity have been compared at two widely separated locations using plasma data obtained in mid-1967 with Mariner 5, en route to Venus, and with the near-earth satellites Explorer 33, 34, and 35. A previous study of the propagation of interplanetary sector boundaries between Mariner and earth had implied the existence of a large-scale gradient in the velocity which we interpreted as a latitude gradient of approximately 13 km/s per degree of latitude. The present investigation extended this earlier study to the overall solar wind without regard to the presence of sector boundaries. Over 2000 hourly averages of the solar wind velocity which originated from essentially the same solar longitudes were compared at Mariner and earth. The quantitative agreement between the two studies implies that the most plausible interpretation of the gradient is that the solar wind velocity is latitude dependent.

RICE, R. F.

R33 RM2: rms Error Comparisons

R. F. Rice

Technical Memorandum 33-804, September 15, 1976

This paper uses the root mean square error performance measure to compare the relative performance of several widely known source coding algorithms with the RM2 image data compression system. The results demonstrate that RM2 has a uniformly significant performance advantage.

RIEGLER, G. P.

R34 Stellar Occultation Measurements of Atmospheric Ozone and Chlorine From OAO 3

G. P. Riegler, J. F. Drake (Princeton University), S. C. Liu (University of Michigan), and R. J. Cicerone (University of Michigan)

J. Geophys. Res., Space Phys., Vol. 81, No. 28, pp. 4997–5001, October 1, 1976

The Princeton University telescope on the Orbiting Astronomical Observatory 3 was used for occultation measurements of upper atmospheric species. The target star, β Cen, and observing date, July 26, 1975, were selected so that the line of sight grazed the earth's limb at local midnight. Observations at 2580, 2825, 2997, 3100, and 3428 Å produced ozone absorption data of high statistical accuracy between 48-km and 114-km tangent altitude. Near-exponential density profiles are obtained up to 85 km. Near 100 km a significant density excess above the extrapolated low-altitude profile is observed. Near-equatorial observations at altitudes up to approximately 75 km agree well with theoretical calculations. Ozone densities measured at 6.5°–12.5°S above approximately 75 km exceed our theoretical calculations and are not understood at the present time. A search for the 1188-Å chlorine line in the 1187-Å O_2 absorption feature was

carried out at tangent altitudes of 96–116 km. An upper limit to the atomic chlorine mixing ratio at 106 km of 3 ppb is found. This upper limit exceeds the expected value for atomic chlorine by a factor of approximately 2.5.

RINKER, G. C.

R35 Statistical Analysis of Trim Maneuvers in Low-Thrust Interplanetary Navigation

G. C. Rinker, R. A. Jacobson, and L. J. Wood (Hughes Aircraft Company)

J. Spacecraft Rockets, Vol. 13, No. 8, pp.509–512, August 1976

An analytical technique is described for determining the statistical properties of the trim maneuver when given the thrust available and the state dispersion and orbit determination covariances at the maneuver time. Also included is a procedure for mapping the covariances through the maneuver with execution errors taken into account. The analytical results are applied to a 1980 solar electric propulsion Encke flyby mission.

ROBINSON, L. B.

R36 Correlation Between Nonequilibrium Thermodynamic Theory and *V-I* Curves of a Thermionic Converter

L. B. Robinson and K. Shimada

J. Appl. Phys., Vol. 47, No. 1, pp. 107–113, January 1976

The methods of irreversible thermodynamics have been used as a basis for developing a transport theory applicable to thermionic cesium diodes. This theory was applied in describing certain aspects of experimental voltage-current (*V-I*) characteristic curves of a thermionic diode. Emphasis, in obtaining the description, is placed on the open-circuit voltage and short-circuit current of the *V-I* curves, obtained at the Jet Propulsion Laboratory. Experimental results show that the open-circuit voltage is essentially independent of the interelectrode spacing, whereas the short-circuit current varies inversely with the interelectrode separation. The inverse dependence is in agreement with the results of this analysis and also with results expected from diffusion theory, which has been used in other analyses. In fact, the theory used in this investigation reduces to diffusion theory under special assumptions. Deviations from diffusion theory, which were found in experimental results, can be accounted for using the theory developed in this paper.

ROCKWELL, S. T.

R37 The Pioneer 11 1976 Solar Conjunction: A Unique Opportunity to Explore the Heliographic Latitudinal Variations of the Solar Corona

A. L. Berman, J. A. Wackley, S. T. Rockwell, and J. G. Yee

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 136–147, October 15, 1976

For abstract, see Berman, A. L.

R38 The 1976 Helios and Pioneer Solar Conjunctions—Continuing Corroboration of the Link Between Doppler Noise and Integrated Signal Path Electron Density

A. L. Berman, J. A. Wackley, and S. T. Rockwell

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 121–137, December 15, 1976

For abstract, see Berman, A. L.

RODEMICH, E. R.

R39 The Effect of Direct Current Bias in the Computation of Power Spectra

E. R. Rodemich

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 53–57, December 15, 1976

We determine the effect of dc bias in the approximate computation of spectra of Gaussian processes by hard limiting.

ROMANOVSKY, J. C.

R40 Interagency Comparison of Iodometric Methods for Ozone Determination

W. B. DeMore, J. C. Romanovsky (Environmental Protection Agency), M. Feldstein (Bay Area Air Pollution Control District, San Francisco), W. J. Hamming (Los Angeles County Air Pollution Control District), and P. K. Mueller (Environmental Research and Technology, Inc.)

Calibration in Air Monitoring, ASTM STP 598, American Society for Testing and Materials, pp. 131–143, 1976

For abstract, see DeMore, W. B.

ROSCHKE, E. J.

R41 **An Experimental Investigation of Fluid Flow and Heating in Various Resonance Tube Modes**

V. Sarohia, L. H. Back, E. J. Roschke, and S. P. Parthasarathy

Technical Memorandum 33-780, September 1, 1976

For abstract, see Sarohia, V.

R42 **The Influence of Upstream Conditions on Flow Reattachment Lengths Downstream of an Abrupt Circular Channel Expansion**

E. J. Roschke and L. H. Back

J. Biomech., Vol. 9, No. 7, pp. 481–483, 1976

The authors compared their flow reattachment data for flow downstream of an abrupt channel expansion with other results reported in the literature. Data was plotted in terms of a dimensionless reattachment length versus the flow Reynolds number in the smaller (upstream) tube; the Reynolds number range was approximately $20 < Re < 4000$. Characteristic curves with a well-defined peak at intermediate Reynolds numbers were evident. Although the flow geometry does influence the reattachment length, it appears, as well, that upstream flow conditions such as the inlet velocity profile have a pronounced effect on the downstream reattachment lengths. It was concluded that the shape of the reattachment-length curve is general for all abrupt channel expansions. However, the level of the curve, the maximum reattachment length, and the Reynolds number at which the maximum occurs depend on both the flow geometry and the flow conditions upstream of the expansion.

R43 **In Vivo Degradation of Silicone Rubber Poppets in Prosthetic Heart Valves**

E. F. Cuddihy, J. Moacanin, E. J. Roschke, and E. C. Harrison (University of Southern California)

J. Biomed. Mater. Res., Vol. 10, No. 3, pp. 471–481, May 1976

For abstract, see Cuddihy, E. F.

ROSENGREN, L.-G.

R44 **Water Vapor Absorption of Carbon Dioxide Laser Radiation**

M. S. Shumate, R. T. Menzies, J. S. Margolis, and L.-G. Rosengren

Appl. Opt., Vol. 15, No. 10, pp. 2480–2488, October 1976

For abstract, see Shumate, M. S.

ROSENTHAL, L. A.

R45 **High Voltage Compliance Constant Current Ballast**

L. A. Rosenthal

IEEE Trans. Ind. Electron. Contr. Instrum., Vol. IECI-23, No. 4, pp. 376–377, November 1976

A ballast circuit employing a constant current diode and a vacuum tube that can provide a constant current over a voltage range of 1000 volts. The simple circuit can prove useful in studying voltage breakdown characteristics.

ROTH, L. E.

R46 **Lunar Cartography With the Apollo 17 ALSE Radar Imagery**

M. F. Tiernan, L. E. Roth, T. W. Thompson, C. Elachi, and W. E. Brown, Jr.

The Moon, Vol. 15, Nos. 1/2, pp. 155–163, January/February 1976

For abstract, see Tiernan, M. F.

ROWAN, L. C.

R47 **Discrimination of Rock Types and Detection of Hydrothermally Altered Areas in South-Central Nevada by the Use of Computer-Enhanced ERTS Images**

L. C. Rowan (U.S. Geological Survey), P. H. Wetlaufer (U.S. Geological Survey), A. F. H. Goetz, F. C. Billingsley, and J. H. Stewart (U.S. Geological Survey)

Geological Survey Professional Paper 883, U. S. Government Printing Office, Washington, 1976

A combination of digital computer processing and color compositing of ERTS Multispectral Scanner images has been used to detect and map hydrothermally altered areas and to discriminate most major rock types in south-central Nevada. The technique is based on enhancement of visible and near-infrared reflectivity differences associated with variations in bulk composition. This technique appears to have important applications in mineral-resources exploration and regional geologic mapping.

ROZEK, J. B.

R48 **An Approach to Improve Management Visibility Within the Procurement and Financial Group at Goldstone**

F. R. Maiocco and J. B. Rozek

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 171–179, October 15, 1976

For abstract, see Maiocco, F. R.

RUDGE, M. R. H.

R49 Electron Scattering by Highly Polar Molecules. I. KI

M. R. H. Rudge, S. Trajmar, and W. Williams

Phys. Rev., Pt. A: Gen. Phys., Vol. 13, No. 6, pp. 2074–2086, June 1976

Electron-impact energy-loss spectra of KI were studied experimentally in the 15- to 130-deg angular range at impact energies of 6.7, 15.7, and 60 eV. The spectra reveal a number of excitation features which have not been detected previously and indicate that KI is a strong photon absorber in the vacuum-uv region. From the spectra, differential and integral electronically elastic and inelastic cross sections have been obtained by normalizing the experimental data to theoretical results at low scattering angles. Rotational excitation cross sections corresponding to $\Delta j = 0, \pm 1$ have been calculated using a dipole-plus-repulsive-core interaction potential and the distorted-wave approximation. For purpose of comparison, the rotational ($\Delta j = \pm 1$) excitation cross sections have also been calculated in the Born point-dipole approximation.

RUMSEY, H., JR.

R50 Venus Radar Images

R. M. Goldstein, R. R. Green, and H. Rumsey, Jr.

J. Geophys. Res., Vol. 81, No. 26, pp. 4807–4817, September 10, 1976

For abstract, see Goldstein, R. M.

RUPE, J H.

R51 New Potentials for Conventional Aircraft When Powered by Hydrogen-Enriched Gasoline

W. A. Menard, P. I. Moynihan, and J H. Rupe

Paper 760469, SAE Business Aircraft Meeting, Wichita, Kansas, April 6–9, 1976

For abstract, see Menard, W. A.

R52 New Potentials for Conventional Aircraft When Powered by Hydrogen-Enriched Gasoline

W. A. Menard, P. I. Moynihan, and J. H. Rupe

Technical Memorandum 33-760, January 15, 1976

For abstract, see Menard, W. A.

RUSSELL, C. T.

R53 Magnetic Permeability Measurements and a Lunar Core

B. E. Goldstein, R. J. Phillips, and C. T. Russell (University of California, Los Angeles)

Geophys. Res. Lett., Vol. 3, No. 6, pp. 289–292, June 1976

For abstract, see Goldstein, B. E.

R54 On the Causes of Spectral Enhancements in Solar Wind Power Spectra

T. Unti and C. T. Russell (University of California, Los Angeles)

J. Geophys. Res., Space Phys., Vol. 81, No. 4, pp. 469–482, February 1, 1976

For abstract, see Unti, T.

R55 On the Apparent Diamagnetism of the Lunar Environment in the Geomagnetic Tail Lobes

B. E. Goldstein and C. T. Russell (University of California, Los Angeles)

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 2999–3012, 1975

For abstract, see Goldstein, B. E.

SALAMA, M. A.

S01 On the Thermoelastic Analysis of Solar Cell Arrays and Related Material Properties

M. A. Salama and F. L. Bouquet

Technical Memorandum 33-753, February 15, 1976

Accurate prediction of failures of solar cell arrays requires corresponding accuracy in the computation of their thermally induced stresses. This was accomplished by using the finite element technique. Certain improvements in the previously reported procedures for stress calculation were introduced together with failure criteria capable of describing a wide range of ductile and brittle material behavior. With these improvements and capabilities, the stress distribution and associated failure mechanisms in the N-interconnect junction of two JPL solar cell designs were discussed and correlated to previous findings.

In such stress and failure analysis, it is essential to know the thermomechanical properties of the materials in-

volved. To complement previous efforts in this direction, new measurements were made of properties of materials suitable for the design of lightweight arrays: namely, the microsheet-0211 glass material for the solar cell filter together with five materials for lightweight substrates (Kapton-H, Kapton-F, Teflon, Tedlar, and Mica-Ply PG-402). The temperature-dependence of the thermal coefficient of expansion for these materials was determined together with other key properties such as the elastic moduli, Poisson's ratio, and the stress-strain behavior up to failure.

With the failure analysis and supporting material property characterization, this work presents a significant advance in the capability of designing solar cell arrays.

SALOMON, P. M.

S02 A Microprocessor-Controlled CCD Star Tracker

P. M. Salomon and W. C. Goss

Preprint 76-116, AIAA Fourteenth Aerospace Sciences Meeting, Washington, D. C., January 26–28, 1976

The STELLAR (Star Tracker for Economical Long Life Attitude Reference) utilizes an image sensing Charge-Coupled Device (CCD) operating under microprocessor control. This approach results in a new type of high-accuracy star tracker which can be adapted to a wide variety of different space flight applications through software changes only. The STELLAR determines two-axis star positions by computing the element and the interelement interpolated centroid positions of the star images. As many as 10 stars may be tracked simultaneously, providing significantly increased stability and accuracy. A detailed description of the STELLAR is presented along with measurements of system performance obtained from an operating breadboard model.

SARANGI, S.

S03 Measurement of Hydrogen- and Self-Broadened Half-Widths of Ammonia at 200 and 300°K

J. S. Margolis and S. Sarangi

J. Quant. Spectros. Radiat. Transfer, Vol. 16, No. 5, pp. 405–408, May 1976

For abstract, see Margolis, J. S.

SAROHIA, V.

S04 An Experimental Investigation of Fluid Flow and Heating in Various Resonance Tube Modes

V. Sarohia, L. H. Back, E. J. Roschke, and S. P. Parthasarathy

Technical Memorandum 33-780, September 1, 1976

Experiments have been performed to study resonance phenomena in tubes excited by underexpanded jet flows. This investigation comprised the following: study of the various resonance tube modes under a wide range of nozzle pressure, spacing between nozzle and tube mouth, and different tube length; the effects of these modes on the endwall pressure and gas temperature; flow visualization of both jet and tube flows by spark shadowgraph technique; and measurement of wave speed inside the tube by the laser-Schlieren techniques. An expensive study of the free-jet flow was undertaken to explain important aspects of various modes of operation of resonance tube flows.

S05 Effects of External Boundary Layer Flow on Jet Noise in Flight

V. Sarohia and P. F. Massier

Preprint 76-558, AIAA Third Aero-Acoust. Conf., Palo Alto, Calif., July 20–23, 1976

The effects on jet flow of the external boundary layer flow emanating from the trailing edge of an engine cowl in flight has been shown to be the main reason for the disparity between predicted and experimental results obtained from flight measurements. Flight simulation experiments indicate that the external boundary layer flow tends to shield the jet flow in flight. This in turn modifies the jet noise source in flight and consequently the radiated noise from aircraft in flight. Close to $\theta_1 = 90$ deg and in the forward quadrant, this study indicates that the far field jet noise and its spectrum scales approximately with the absolute jet velocity instead of the relative velocity as has been assumed in the existing prediction models.

SATO, T.

S06 Development of a Water Vapor Radiometer to Correct for Tropospheric Range Delay in DSN Applications

P. D. Batelaan, T. Sato, S. D. Slobin, and H. F. Reilly, Jr.

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 77–84, June 15, 1976

For abstract, see Batelaan, P. D.

SAUNDERS, R. S.

S07 The Geology and Geophysics of Mars

R. S. Saunders

Endeavour, Vol. XXXV, No. 124, pp. 15–20, January 1976

The exploration of Mars by orbiting spacecraft—as a preliminary to a landing—has yielded a wealth of new knowledge about the configuration and structure of the planet. Ideas that prevailed up to 1965, ascribing to Mars many Earth-like features, have had to be radically revised. This article reviews new knowledge gained predominantly from the Mariner series of space flights.

S08 Vidicon Spectral Imaging: Color Enhancement and Digital Maps

T. V. Johnson, D. L. Matson, R. J. Phillips, and R. S. Saunders

Proc. Sixth Lunar Sci. Conf. (Suppl. 6 *Geochim. Cosmochim. Acta*), pp. 2677–2688, 1975

For abstract, see Johnson, T. V.

S09 The Geologic Development of Mars: A Review

T. A. Mutch (Brown University) and R. S. Saunders

Space Sci. Rev., Vol. 19, No. 1, pp. 3–57, June 1976

For abstract, see Mutch, T. A.

SCHABER, G. G.

S10 Final Report: Apollo Experiment S-217 IR/Radar Study of Apollo Data

T. W. Thompson, H. J. Moore (United States Geological Survey), G. G. Schaber (United States Geological Survey), R. W. Shorthill (University of Utah), E. A. Whitaker (University of Arizona), and S. H. Zisk (NEROC Haystack Observatory)

Technical Memorandum 33-787, October 1, 1976

For abstract, see Thompson, T. W.

SCHLAIFER, R. S.

S11 A New Algorithm for Predicting the Apparent Polarization Angle of Linearly Polarized Spacecraft

R. S. Schlaifer

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 194–198, June 15, 1976

With the advent of nonecliptic spacecraft orbits and the inclusion of a NASA X-Y mounted antenna within the DSN, it has become apparent that the current polarization angle prediction formulas may be insufficient for future needs. This article presents a new formulation for predicting the polarization angle which properly accommodates these new features in a concise, straightforward form.

SCHREINER, W. D.

S12 Modification of Hipotronics Discontinuity Enamel Wire Test for Wire Screening

W. D. Schreiner

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 102–104, December 15, 1976

The Quality Assurance DSN and Mechanical Hardware Section and the Fabrication Section have redesigned the wire spindle section of the wire screening test equipment to prevent breakage of small gage magnet wire during testing operations.

SCHURMEIER, H. M.

S13 Planetary Exploration: Earth's New Horizon

H. M. Schurmeier

J. Spacecraft Rockets, Vol. 12, No. 7, pp. 385–405, July 1975

Planetary exploration is examined in terms of the interaction of technological growth with scientific progress within the limits of the unmanned exploration of the planets of the solar system. A descriptive model is presented, and activities and achievements of the past decade, the current state-of-the art, and planetary mission opportunities for the next decade are discussed. The conclusions enumerate the benefits planetary exploration offers to the public.

SELZER, R. H.

S14 Digital Image Processing of Vascular Angiograms

R. H. Selzer, D. H. Blankenhorn (University of Southern California), E. S. Beckenbach, D. W. Crawford (University of Southern California), and S. H. Brooks (University of Southern California)

Proc. SPIE Conf. Cardiovascular Imaging and Image Processing, Theory and Practice, Stanford, Calif., July 1975, Vol. 72, pp. 159–162

The article describes a computer image processing technique developed to estimate the degree of atherosclerosis in the human femoral artery. With an angiographic film of the vessel as input, the computer has been programmed to estimate vessel abnormality through a series of

measurements, some derived primarily from the vessel edge information and others from optical density variations within the lumen shadow. These measurements are combined into an atherosclerosis index, which was found to correlate well with both visual and chemical estimates of atherosclerotic disease.

SERNAS, V.

S15 Role of Thermal Contact Resistance in Pyrotechnic Ignition

V. Sernas (Rutgers University) and A. J. Murphy

J. Spacecraft Rockets, Vol. 12, No. 12, pp. 782–784, December 1975

Small charges of pyrotechnic squibs are used to separate spacecraft from their launch vehicles, unfolding solar panels, releasing communications antennas, and other work in space. This Note presents a simplified model of a pyrotechnic and examines how a thermal contact resistant can influence the time to ignition and the instantaneous temperature distributions within the bridgewire-pyrotechnic system.

SHIMABUKURO, F. I.

S16 Microwave Measurement of Mesospheric Carbon Monoxide

J. W. Waters, W. J. Wilson (Aerospace Corporation), and F. I. Shimabukuro (Aerospace Corporation)

Science, Vol. 191, No. 4232, pp 1174–1175, March 19, 1976

For abstract, see Waters, J. W.

SHIMADA, K.

S17 Low Work Function Silicon Collector for Thermionic Converters

K. H. Chang and K. Shimada

Technical Memorandum 33-775, May 15, 1976

For abstract, see Chang, K. H.

S18 Correlation Between Nonequilibrium Thermodynamic Theory and *V-I* Curves of a Thermionic Converter

L. B. Robinson and K. Shimada

J. Appl. Phys., Vol. 47, No. 1, pp. 107–113, January 1976

For abstract, see Robinson, L. B.

SHORTHILL, R. W.

S19 Final Report: Apollo Experiment S-217 IR/Radar Study of Apollo Data

T. W. Thompson, H. J. Moore (United States Geological Survey), G. G. Schaber (United States Geological Survey), R. W. Shorthill (University of Utah), E. A. Whitaker (University of Arizona), and S. H. Zisk (NEROC Haystack Observatory)

Technical Memorandum 33-787, October 1, 1976

For abstract, see Thompson, T. W.

SHUMATE, M. S.

S20 Optoacoustic Measurements of Water Vapor Absorption at Selected CO Laser Wavelengths in the 5-μm Region

R. T. Menzies and M. S. Shumate

Appl. Opt., Vol. 15, No. 9, pp. 2025–2027, September 1976

For abstract, see Menzies, R. T.

S21 Remote Measurements of Ambient Air Pollutants With a Bistatic Laser System

R. T. Menzies and M. S. Shumate

Appl. Opt., Vol. 15, No. 9, pp. 2080–2084, September 1976

For abstract, see Menzies, R. T.

S22 Water Vapor Absorption of Carbon Dioxide Laser Radiation

M. S. Shumate, R. T. Menzies, J. S. Margolis, and L.-G. Rosengren

Appl. Opt., Vol. 15, No. 10, pp. 2480–2488, October 1976

An optoacoustic detector or spectrophone has been used to perform detailed measurements of the absorptivity of mixtures of water vapor in air. A $C^{12}O_2{}^{16}$ laser was used as the source, and measurements were made at forty-nine different wavelengths from 9.2 to 10.7 μm. The details of the optoacoustic detector and its calibration are presented, along with a discussion of its performance characteristics. The results of the measurements of water vapor absorption show that the continuum absorption in the wavelength range covered is 5–10% lower than previous measurements.

SIDHU, G. S.

S23 Integration-Free Interval Doubling for Riccati Equation Solutions

G. J. Bierman and G. S. Sidhu (State University of New York)

Technical Memorandum 33-799, October 1, 1976

For abstract, see Bierman, G. J.

SIEGAL, B. S.

S24 Geologic Mapping Using LANDSAT Data

B. S. Siegal and M. J. Abrams

Photogram. Eng. Remote Sensing, Vol. 42, No. 3, pp. 325–337, March 1976

The feasibility of automated classification for lithologic mapping with LANDSAT digital data was evaluated by using three classification algorithms. The two supervised algorithms analyzed, a linear discriminant analysis algorithm and a hybrid algorithm which incorporated the Parallelepiped algorithm and the Bayesian maximum likelihood function, were comparable in terms of accuracy; however, classification was only 50 per cent accurate. The linear discriminant analysis algorithm was three times as efficient as the hybrid approach. The unsupervised classification technique, which incorporated the CLUS algorithm, delineated the major lithologic boundaries and, in general, correctly classified the most prominent geologic units. The unsupervised algorithm was not as efficient nor as accurate as the supervised algorithms. The inability of all the classification schemes to portray correctly the lithologic units reflects the inhomogeneity of the geologic units and the similarity of their spectral signatures in the wavelength bands measured by LANDSAT. Analysis of spectral data for the lithologic units in the 0.4 to 2.5 μm region, as obtained by a portable field reflectance spectrometer, indicated that a greater separability could be obtained using wavelength bands outside the region sensed by LANDSAT.

SIEVERS, M. W.

S25 An Automated Tracking System for the ARIES Antenna

M. W. Sievers

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 139–150, April 15, 1976

A miniprocessor-based tracking system has been developed for the Astronomical Radio Interferometric Earth Surveying (ARIES) antenna. The system is a servo loop in which tracking errors and correction commands are calculated in software.

S26 An INTEL 8080 Cross Assembler for the Modcomp II Minicomputer

M. W. Sievers

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 151–163, April 15, 1976

The flexibility of Modcomp's macro assembler has been exploited to implement an INTEL 8080 cross assembler. This simple implementation is very powerful, allowing, for example, macro definitions, and declaration of common and external labels. The cross assembler may be executed on any Modcomp II minicomputer.

S27 Hardware Additions to Microprocessor Architecture Aid Software Development

M. W. Sievers

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 28–33, October 15, 1976

Simple additions to a microprocessor's architecture provide a programmer with two powerful debugging aids. These aids are useful both for initial software development and for routine system integrity diagnostics. One of these aids may be expanded into a virtual machine system.

SILVER, R. H.

S28 Accelerated Heat-Aging Studies on Fluorosilicone Rubber

S. H. Kalfayan, R. H. Silver, and A. A. Mazzeo

Rubber Chem. Technol., Vol. 48, No. 5, pp. 944–952, November–December 1975

For abstract, see Kalfayan, S. H.

S29 Accelerated Heat-Aging Studies on Fluororubber in Various Media

S. H. Kalfayan, R. H. Silver, and S. S. Liu

Rubber Chem. Technol., Vol. 49, No. 4, pp. 1001–1009, September–October 1976

For abstract, see Kalfayan, S. H.

SIMMONS, K. E.

S30 Mariner 9 Ultraviolet Spectrometer Experiment: Bright-Limb Observations of the Lower Atmosphere of Mars

J. M. Ajello, K. D. Pang, A. L. Lane, C. W. Hord (University of Colorado), and K. E. Simmons (University of Colorado)

J. Atmos. Sci., Vol. 33, No. 3, pp. 544–552, March 1976

For abstract, see Ajello, J. M.

SIMON, M. K.

S31 A Generalization of Minimum-Shift-Keying (MSK)-Type Signaling Based Upon Input Data Symbol Pulse Shaping

M. K. Simon

IEEE Trans. Commun., Vol. COM-24, No. 8, pp. 845–856, August 1976

In recent years, minimum-shift-keying (MSK) has gained increasing popularity as a modulation technique because of its desirable spectral properties. Quite often, the spectral concentration provided by MSK is not sufficient to meet requirements on out-of-band energy spillover. In these situations, one might apply additional input pulse shaping in such a way as to still maintain constant envelope signals. The properties of such MSK-type signals are the subject of this paper. Specific examples are included as illustrations of the theory both for the binary and M-ary cases.

S32 An MSK Approach to Offset QASK

M. K. Simon

IEEE Trans. Commun., Vol. COM-24, No. 8, pp. 921–923, August 1976

This paper demonstrates that an offset quadrature amplitude-shift-keyed (OQASK) signal can be represented as an n-component version of a minimum-shift-keyed (MSK) signal. For example, the signal set obtained by summing two MSK signals which are 6 dB different in power and are formed by continuous phase, frequency modulating the same oscillator with two independent binary antipodal data streams, is spectrally equivalent to an OQASK signal set composed of 16 signals in which the symbol pulse is a half-cycle sinusoid rather than the conventional rectangular form. Such generalizations as the above allow for potentially simpler implementation of spectrally shaped OQASK.

SIMPSON, J. A.

S33 Jovian Electron Bursts: Correlation With the Interplanetary Field Direction and Hydromagnetic Waves

E. J. Smith, B. T. Tsurutani, D. L. Chenette (University of Chicago), T. F. Conlon (University of Chicago), and J. A. Simpson (University of Chicago)

J. Geophys. Res., Space Phys., Vol. 81, No. 1, pp. 65–72, January 1, 1976

For abstract, see Smith, E. J.

SINES, G.

S34 Methods for Determining the Strength of Brittle Materials in Compressive Stress States

M. Adams and G. Sines (University of California Engineering College)

J. Test. Eval., Vol. 4, No. 6, pp. 383–396, November 1976

For abstract, see Adams, M.

SJOGREN, W. L.

S35 Gravity Fields

W. L. Sjogren, J. D. Anderson, R. J. Phillips, and D. W. Trask

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 172–183, July 1976

Doppler radio tracking of deep space probes near extraterrestrial bodies has provided information on the internal mass distribution for Jupiter, Mars, the Moon, Venus, and Mercury. The more detailed results have been obtained for Mars and the Moon where orbiting spacecraft (Mariner 9 and Apollo) have returned a vast amount of gravity data. The instrumentation to acquire the data consists of a spacecraft transponder and an Earth-based ultrastable frequency oscillator, along with appropriate transmitters, receivers, and antennas. The necessary data reduction to extract the gravity parameters from the Doppler signal variations requires a very complex computer program.

The major achievements have been the detailed results for Mars and the Moon where global gravity fields reveal high correlation with topography. Present investigations on isostatic conditions are constraining viscosity estimates, and it appears that viscosity at various eras may be determined. Apollo data at very low altitudes (15–20 km) have provided gravity profiles for frontside mascons, craters, and mountain chains. The determinations of the first three even zonal spherical harmonic coefficients for Jupiter places constraints on the interior as well as the outer envelope. A proposed cross section of Jupiter is shown, composed primarily of hydrogen and helium in different states. Some comments are made on Mercury, Venus, and Jupiter's Galilean satellites.

SKJERVE, L. J.

S36 ALSEP–Quasar Differential VLBI

M. A. Slade, R. A. Preston, A. W. Harris, L. J. Skjerve, and D. J. Spitzmesser

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 37–54, June 15, 1976

For abstract, see Slade, M. A.

S37 2290-MHz Flux Densities of 52 High-Declination Radio Sources

A. W. Harris, R. A. Preston, D. J. Spitzmesser, M. A. Slade, and L. J. Skjerve

Astron. J., Vol. 81, No. 4, pp. 222–224, April. 1976

For abstract, see Harris, A. W.

S38 A Demonstration of an Independent-Station Radio Interferometry System With 4-cm Precision on a 16-km Base Line

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, L. J. Skjerve, D. J. Spitzmesser, and H. F. Fliegel

J. Geophys. Res., Vol. 81, No. 5, pp. 995–1005, February 10, 1976

For abstract, see Thomas, J. B.

S39 A Demonstration of a Transportable Radio Interferometric Surveying System With 3-cm Accuracy on a 307-m Base Line

K. M. Ong, P. F. MacDoran, J. B. Thomas, H. F. Fliegel, L. J. Skjerve, D. J. Spitzmesser, P. D. Batelaan, S. R. Paine, and M. G. Newsted (Trend Western Engineering Corporation)

J. Geophys. Res., Vol. 81, No. 20, pp. 3587–3593, July 10, 1976

For abstract, see Ong, K. M.

SLADE, M. A.

S40 ALSEP–Quasar Differential VLBI

M. A. Slade, R. A. Preston, A. W. Harris, L. J. Skjerve, and D. J. Spitzmesser

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 37–54, June 15, 1976

A program of Apollo Lunar Surface Experiments Package (ALSEP)–Quasar Very Long Baseline Interferometry (VLBI) is being carried out at the Jet Propulsion Laboratory. These observations primarily employ a 4-antenna technique, whereby simultaneous observations with two antennas at each end of an intercontinental baseline are used to derive the differential interferometric phase between a compact extragalactic radio source (usually a quasar) and a number of ALSEP transmitters on the lunar surface. A continuous ALSEP–quasar differential phase history over a few-hour period can lead to extremely high angular accuracy (less than approximately 0.001 arc-second) in measuring the lunar position against the quasar reference frame. Development of this application of the 4-antenna technique has been underway at JPL for more than a year and is now producing high-quality data utilizing Deep Space Network stations in Australia, Spain, and Goldstone, California, as well as the Spaceflight Tracking and Data Network (STDN) "Apollo" station at Goldstone. These high accuracy observations are of value to tie the lunar ephemeris to a nearly inertial extragalactic reference frame, to test gravitational theories, and to measure the Earth–moon tidal friction interaction.

S41 2290-MHz Flux Densities of 52 High-Declination Radio Sources

A. W. Harris, R. A. Preston, D. J. Spitzmesser, M. A. Slade, and L. J. Skjerve

Astron. J., Vol. 81, No. 4, pp. 222–224, April 1976

For abstract, see Harris, A. W.

SLOBIN, S. D.

S42 Development of a Water Vapor Radiometer to Correct for Tropospheric Range Delay in DSN Applications

P. D. Batelaan, T. Sato, S. D. Slobin, and H. F. Reilly, Jr.

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 77–84, June 15, 1976

For abstract, see Batelaan, P. D.

SMITH, E. J.

S43 Observations of Interaction Regions and Corotating Shocks Between One and Five AU: Pioneers 10 and 11

E. J. Smith and J. H. Wolfe (Ames Research Center)

Geophys. Res. Lett., Vol. 3, No. 3, pp. 137–140, March 1976

Interaction regions between adjacent solar wind streams have been identified between 1 and 5 AU, using Pioneer 10 and 11 magnetic field and plasma measurements. Beyond 1 AU, a relatively large fraction of the interaction regions has been found to be accompanied by either forward shocks, reverse shocks, or shock pairs. The observations are consistent with previous theoretical proposals that the interaction between adjacent streams leads to the development of corotating interplanetary shocks.

S44 Extraterrestrial Magnetic Fields: Achievements and Opportunities

E. J. Smith and C. P. Sonett (University of Arizona)

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 154–171, July 1976

The major scientific achievements associated with the measurement of magnetic fields in space over the past decade and a half are reviewed. Aspects of space technology relevant to magnetic-field observations are discussed, including the different types of magnetometers used and how they operate, problems arising from spacecraft-generated magnetic fields and the appropriate countermeasures that have been developed and on-board processing of magnetometer data. The scientific discussion is restricted to only the major achievements; however, all major topics are covered, specifically: the solar wind and interplanetary magnetic field, the Earth's magnetic field in space, the interaction of the solar wind with the planets, planetary magnetic fields, and the permanent magnetic fields of the Moon. A brief description is also included of future missions now scheduled for launch which should contribute significantly to the understanding of extraterrestrial magnetic fields. A fairly complete bibliography is included which lists original contributions as well as more recent publications and review articles.

S45 Jovian Electron Bursts: Correlation With the Interplanetary Field Direction and Hydromagnetic Waves

E. J. Smith, B. T. Tsurutani,
D. L. Chenette (University of Chicago),
T. F. Conlon (University of Chicago), and
J. A. Simpson (University of Chicago)

J. Geophys. Res., Space Phys., Vol. 81, No. 1, pp. 65–72, January 1, 1976

The bursts of relativistic electrons detected on Pioneer 10 upstream from Jupiter and within $400r_J$ of the planet have been found to be correlated with the interplanetary magnetic field. In the three examples upon which this study is based, during the month prior to the Pioneer 10 encounter, electrons with energies between 3 and 5 MeV escaping from Jupiter's magnetosphere were observed only when the interplanetary magnetic field was along the Jupiter-spacecraft line. In addition, large-amplitude interplanetary waves with characteristic periods of 10 min were observed and found to be well correlated with intervals during which the field was along the Jupiter-spacecraft line. Abrupt changes in the field away from the preferred direction caused equally abrupt terminations of the waves with an accompanying reduction in the electron flux. These results are consistent with propagation of the electrons from Jupiter to Pioneer along, rather than across, the magnetic field lines. The direction of the interplanetary magnetic field is apparently not affected by the electron bursts or by other particles from Jupiter. A histogram of 1-min averages of the interplanetary magnetic field longitude during the period of the study clearly shows the average Parker spiral direction with no enhancement in the Jupiter-spacecraft direction. Two alternative possibilities are considered for the origin of the waves. If they were generated near Jupiter, they would have to propagate to the spacecraft in the whistler mode. The expected attenuation of these waves over distances of several hundred r_J and their long travel times make this explanation unattractive. Alternatively, hydromagnetic wave generation by Jovian charged particles, presumably the relativistic electrons themselves, as they travel upstream, appears to be an attractive explanation. At the observed frequency, hydromagnetic waves are Doppler-shifted to the gyrofrequency of the relativistic electrons. A plasma instability that appears capable of explaining the observations is a cyclotron overstability originally discovered in thermonuclear research that occurs when the velocity of runaway electrons exceeds the velocity of hydromagnetic waves.

S46 Evidence of a Large-Scale Gradient in the Solar Wind Velocity

E. J. Rhodes, Jr. and E. J. Smith

J. Geophys. Res., Space Phys., Vol. 81, No. 13, pp. 2123–2134, May 1, 1976

For abstract, see Rhodes, E. J., Jr.

S47 Magnetosheath Lion Roars

E. J. Smith and B. T. Tsurutani

J. Geophys. Res., Space Phys., Vol. 81, No. 13, pp. 2261–2266, May 1, 1976

Lion roars, which are intense packets of electromagnetic waves characteristically found in the magnetosheath, have been studied. The average frequency of the emissions is 120 Hz with over 90% occurring between 90 and 160 Hz; these results imply that the observed frequencies

are near one-half the local electron gyrofrequency. The duration of the emissions is relatively short, over 70% of all emissions lasting less than 2 s. The maximum amplitude of the lion roars is found to have an average value of 85 mγ, over 80% of the amplitudes being between 40 and 160 mγ. The occurrence of lion roars is related to the level of geomagnetic activity as measured by *Kp*. The probability of occurrence ranges from 10% in magnetically quiet intervals to 75% during disturbed periods. The polarization and wave normal direction of lion roars, determined by variance analyses of the triaxial wave forms, are found to be right-hand circularly polarized with propagation essentially along the ambient magnetic field. More than 75% of all events analyzed were found to propagate at angles of less than 30° to the magnetic field. A correlation between decreases in the magnetic field magnitude and the occurrence of lion roars has been observed. Typically, the lion roars start as the field magnitude decreases and end as the magnitude recovers. On the basis of these observations, several possible wave generation mechanisms are examined. Landau resonance is considered to be an unlikely source because this mechanism requires a substantial component of the wave electric field parallel to B, and the observation that the waves propagate along the ambient field is contrary to this requirement. It is not obvious that electron cyclotron resonance is responsible, because the field magnitude decreases should cause $T/T_{\perp}$ to increase, and this rise could lead to wave damping rather than wave growth. A model which is consistent with all the observations of this study is a proton cyclotron overstability involving 10-keV protons streaming through the magnetosheath. It appears possible that the streaming protons could produce both the waves and the field decreases and that all three would be coincident.

SMITH, R. M.

S48 An MBASIC Application Program for Relational Inquiries on a Database

R. M. Smith

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 100–107, August 15, 1976

An MBASIC application program is described that allows a user to specify and perform a sequence of relational operations on a database.

S49 Two MBASIC Programs That Write Application Programs for Accessing a Database

R. M. Smith

The Deep Space Network· September and October 1976, DSN Progress Report 42-36, pp. 105–113, December 15, 1976

A method was desired to relieve the tedium of writing and testing application programs. Two utility programs were developed to produce application programs that perform relational operations on data. No coding is performed by the user.

SOHA, J. M.

S50 Document Restoration by Digital Image Processing

W. H. Spuck, R. J. Blackwell, and J. M. Soha

Amer. Arch., Vol. 39, No. 2, pp. 131–155, April 1976

For abstract, see Spuck, W. H.

SOLOMON, G.

S51 Decoding with Multipliers

L. D. Baumert, R. J. McEliece, and G. Solomon

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 43–46, August 15, 1976

For abstract, see Baumert, L. D.

SOMOANO, R. B.

S52 The Electrical and Magnetic Properties of $(TTF)(I)_{0.71}$

R. B. Somoano, A. Gupta, V. Hadek, T. Datta (Tulane University), M. Jones (Tulane University), R. Deck (Tulane University), and A. M. Hermann (Tulane University)

J. Chem. Phys., Vol. 63, No. 11, pp. 4970–4976, December 1, 1975

The synthesis and transport properties of the salts (TTF)(iodine)$_x$ have been investigated. These salts are quasi-one-dimensional compounds containing cation radicals only, in contrast to the cation radical-anion radical systems such as (TTF)(TCNQ). The phase diagram of $(TTF)(I)_x$ is discussed, and found to consist of two nonconducting, stoichiometric phases, $x = 2.0$ and 3.0, and two conducting, nonstoichiometric phases, $x = 0.71$ and 2.3. The transport properties of $(TTF)(I)_{0.71}$ are discussed in detail. This phase is highly conducting, $\sigma_{RT} \sim 350\ \Omega^{-1}\cdot cm^{-1}$, undergoes a sharp transition to a less conducting state at ~210 K, and exhibits an unusual hysteresis in some of the transport properties upon thermal cycling. The nature of the high temperature ground state is examined.

SONETT, C. P.

S53 **Extraterrestrial Magnetic Fields: Achievements and Opportunities**

E. J. Smith and C. P. Sonett (University of Arizona)

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 154–171, July 1976

For abstract, see Smith, E. J.

SOVERO, E.

S54 **Electron Temperature Measurements in a Copper Chloride Laser Utilizing a Microwave Radiometer**

E. Sovero (California Institute of Technology), C. J. Chen (California Institute of Technology), and F. E. C. Culick (California Institute of Technology)

J. Appl. Phys., Vol. 47, No. 10, pp. 4538–4542, October 1976

The electron temperature as a function of laser tube temperature of a copper vapor laser utilizing copper chloride as a lasant has been obtained by measuring the microwave incoherent radiation from the plasma in the laser tube. An unexpected increase of electron temperature at higher laser tube temperature may be due mainly to Penning ionization of the Cu atom by the metastable state of He or Ne buffer gases. The results obtained in this work provide part of the basis for understanding the behavior of the laser output as a function of tube temperature.

SPITZMESSER, D. J.

S55 **ALSEP–Quasar Differential VLBI**

M. A. Slade, R. A. Preston, A. W. Harris, L. J. Skjerve, and D. J. Spitzmesser

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 37–54, June 15, 1976

For abstract, see Slade, M. A.

S56 **2290-MHz Flux Densities of 52 High-Declination Radio Sources**

A. W. Harris, R. A. Preston, D. J. Spitzmesser, M. A. Slade, and L. J. Skjerve

Astron. J., Vol. 81, No. 4, pp. 222–224, April 1976

For abstract, see Harris, A. W.

S57 **A Demonstration of an Independent-Station Radio Interferometry System With 4-cm Precision on a 16-km Base Line**

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, L. J. Skjerve, D. J. Spitzmesser, and H. F. Fliegel

J. Geophys. Res., Vol. 81, No. 5, pp. 995–1005, February 10, 1976

For abstract, see Thomas, J. B.

S58 **A Demonstration of a Transportable Radio Interferometric Surveying System With 3-cm Accuracy on a 307-m Base Line**

K. M. Ong, P. F. MacDoran, J. B. Thomas, H. F. Fliegel, L. J. Skjerve, D. J. Spitzmesser, P. D. Batelaan, S. R. Paine, and M. G. Newsted (Trend Western Engineering Corporation)

J. Geophys. Res., Vol. 81, No. 20, pp. 3587–3593, July 10, 1976

For abstract, see Ong, K. M.

SPRADLIN, G. L.

S59 **DSS Range Delay Calibration: Current Performance Level**

G. L. Spradlin

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 138–152, December 15, 1976

It is the intent of this report to describe a task undertaken approximately 18 months ago, under the auspices of the Ranging Accuracy Team, to develop a means for evaluating Deep Space Station (DSS) range delay calibration performance, and through which inconsistencies frequently noted in these data could be resolved. Development of the DSS range delay data base is described. The data base is presented with comments regarding apparent discontinuities. Data regarding the exciter frequency dependence of the delay values are presented, and the report concludes by noting the improvement observed in the consistency of current DSS range delay calibration data over the performance previously observed.

SPUCK, W. H.

S60 **Document Restoration by Digital Image Processing**

W. H. Spuck, R. J. Blackwell, and J. M. Soha

Amer. Arch., Vol. 39, No. 2, pp. 131–155, April 1976

This paper discusses the digital image processing system of document restoration and gives four samples of restoration.

SRIVASTAVA, S. K.

S61 Absolute Elastic Differential Electron Scattering Cross Sections in the Intermediate Energy Region. II.—N_2

S. K. Srivastava, A. Chutjian, and S. Trajmar

J. Chem. Phys., Vol. 64, No. 4, pp. 1340–1344, February 15, 1976

Utilizing a recently developed method, the ratios of elastic differential cross sections (DCS) of N_2 to those of He have been measured at electron impact energies of 5, 7, 10, 15, 20, 30, 40, 50, 60 and 75 eV covering an angular range of 20° to 135° at each energy. The absolute values of N_2DCS (which, in the present work, also include the DCS for pure rotational excitation) have been obtained from these ratios by the use of absolute He DCS of McConkey and Preston. From the differential cross sections, elastic integral and momentum transfer cross sections have been evaluated. The results of the present experiment are compared with some previous measurements.

S62 Absolute Elastic Differential Electron Scattering Cross Sections in the Intermediate Energy Region. III. SF_6 and UF_6

S. K. Srivastava, S. Trajmar, A. Chutjian, and W. Williams

J. Chem. Phys., Vol. 64, No. 7, pp. 2767–2771, April 1, 1976

A recently developed technique has been used to measure the ratios of elastic differential electron scattering cross sections (DCS) for SF_6 and UF_6 to those of He at electron impact energies of 5, 10, 15, 20, 30, 40, 50, 60, and 75 eV and at scattering angles of 20° to 135°. In order to obtain the absolute values of DCS from these ratios, He DCS of McConkey and Preston have been employed in the 20° to 90° range. At angles in the 90° to 135° range the recently determined cross sections of Srivastava and Trajmar have been utilized. From these DCS, elastic integral and momentum transfer cross sections have been obtained.

S63 Differential Elastic Cross Sections for High Angle Electron Scattering by He in the Intermediate Energy Region

S. K. Srivastava and S. Trajmar

J. Chem. Phys., Vol. 64, No. 9, pp. 3886–3888, May 1, 1976

This letter to the editor reports on an extension of the differential cross sections for scattering angles by helium between 90 and 135° at impact energies ranging from 5 to 75 eV. Comparisons are given of present measurements at 10 and 50 eV impact energies with previous results.

S64 Electron-Impact Excitation of UF_6 at an Electron Energy of 20 eV in the Energy-Loss Range of 0–10 eV

A. Chutjian, S. K. Srivastava, S. Trajmar, W. Williams, and D. C. Cartwright (Los Alamos Scientific Laboratory)

J. Chem. Phys., Vol. 64, No. 11, pp. 4791–4793, June 1, 1976

For abstract, see Chutjian, A.

S65 Photoabsorption Spectrum of UF_6 by Electron Impact

S. K. Srivastava, D. C. Cartwright (Los Alamos Scientific Laboratory), S. Trajmar, A. Chutjian, and W. Williams

J. Chem. Phys., Vol. 65, No. 1, pp. 208–211, July 1, 1976

The photoabsorption cross section of UF_6 in the wavelength region between 206.7 nm (2.5 eV) and 43.5 nm (28.5 eV) has been derived from the UF_6 electron energy loss spectra at a 5-deg scattering angle and at incident electron energies of 75 and 100 eV. The shape of the resulting optical spectrum agrees well with available high-resolution photoabsorption measurements in the 400 nm (3.1 eV) to 200 nm (6.3 eV) region. Below 200 nm, where no photoabsorption data are available, there is strong absorption and appreciable structure present. Absolute values of absorption cross sections have been obtained by normalizing the present relative data to the recently measured photoabsorption value at 225.5 nm.

STAELIN, D. H.

S66 Microwave Remote Sensing of Atmospheric Temperatures From the Nimbus 5 Satellite

J. W. Waters, D. H. Staelin (Massachusetts Institute of Technology), K. F. Kunzi (Massachusetts Institute of Technology), R. L. Pettyjohn (Massachusetts Institute of Technology), and R. K. L. Poon (Massachusetts Institute of Technology)

Space Research XV, pp. 117–121, Akademie-Verlag, Berlin, 1975

For abstract, see Waters, J. W.

STANDISH, E. M., JR.

S67 JPL Development Ephemeris Number 96

E. M. Standish, Jr., M. S. W. Keesey, and X X Newhall

Technical Report 32-1603, February 29, 1976

The fourth issue of JPL Planetary Ephemerides, designated JPL Development Ephemeris No. 96 (DE96), is described. This ephemeris replaces DE69, which has become obsolete since its release in 1969. The improvements in DE96 include more recent and more accurate observational data, new types of data, better processing of the data, and refined equations of motion which more accurately describe the actual physics of the solar system. The descriptions in this report include these new features as well as the new export version of the ephemeris.

STANLEY, A. G.

S68 Radiation Design Criteria Handbook

A. G. Stanley, K. E. Martin, and S. Douglas

Technical Memorandum 33-763, August 1, 1976

This handbook provides radiation design criteria for electronic parts applications in space environments. The data was compiled from the Mariner/Jupiter Saturn 1977 (MJS'77) electronic parts radiation test program. In this program selected radiation-sensitive device types were exposed to radiation environments compatible with the MJS'77 requirements under suitable bias conditions. A total of 189 integrated circuits, transistors, and other semiconductor device types were tested up to 1.5×10^5 rads(Si) generated from steady electron beam and Co^{60} sources.

S69 Irradiate-Anneal Screening of Total Dose Effects in Semiconductor Devices

A. G. Stanley and W. E. Price

Technical Memorandum 33-788, July 15, 1976

An extensive investigation of irradiate-anneal (IRAN) screening against total dose radiation effects was carried out as part of a program to harden the Mariner Jupiter/Saturn 1977 spacecraft to survive the Jupiter radiation belts. The method consists of irradiating semiconductor devices with Cobalt-60 to a suitable total dose under representative bias conditions and of separating the parts in the undesired tail of the distribution from the bulk of the parts by means of a predetermined acceptance limit. The acceptable devices are then restored close to their preirradiation condition by annealing them at an elevated temperature. IRAN was used when lot screen methods were impracticable due to lack of time, and when members of a lot showed a diversity of radiation response.

STANTON, P. H.

S70 The Effects of an Ion-Thruster Exhaust Plume of S-Band Carrier Transmission

W. E. Ackerknecht III and P. H. Stanton

Technical Memorandum 33-754, January 1, 1976

For abstract, see Ackerknecht, W. E., II

STANTON, R. H.

S71 Optical Guidance Vidicon Test Program Final Report

A. R. Eisenman, R. H. Stanton, and C. C. Voge

Technical Memorandum 33-796, September 15, 1976

For abstract, see Eisenman, A. R.

STEARNS, J. W.

S72 Large-Payload Earth-Orbit Transportation With Electric Propulsion

J. W. Stearns

Technical Memorandum 33-793, September 15, 1976

Economical unmanned Earth-orbit transportation for large payloads is evaluated. The high exhaust velocity achievable with electric propulsion is attractive because it will minimize the propellant that must be carried to low Earth orbit. Propellant transport is a principal cost item. Electric propulsion subsystems utilizing advanced ion thrusters are compared to MPD thrust subsystems. For very large payloads, a Large Lift Vehicle is needed to low Earth orbit, and argon propellant is required for electric propulsion. Under these circumstances, this study shows the MPD thruster to be desirable over the ion thruster for Earth-orbit transportation. Both solar-electric and nuclear-electric power supplies were considered.

STELZRIED, C. T.

S73 DSS 14 Operating Noise Temperature During Helios 1 Near-Sun Tracking

C. T. Stelzried and D. Girdner

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 68–76, June 15, 1976

When spacecraft are tracked near the line-of-sight of the Sun, the ground antenna sidelobes "see" the solar noise. The solar noise increases the ground system operating noise temperature and degrades the downlink RF reception performance. At specific antenna azimuthal angles relative to the Sun, noise peaks and nulls occur periodically throughout a day's tracking pass due to the quadripod support leg-generated sidelobes. This article documents this effect while tracking Helios 1, illustrates the time of the peaks, and compares the predicted time of the noise temperature peaks with the measured data.

S74 Computation of Spacecraft Signal Raypath Trajectories Relative to the Sun

A. R. Cannon and C. T. Stelzried

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 33–38, August 15, 1976

For abstract, see Cannon, A. R.

STEVENS, G. L.

S75 Precision Signal Power Measurement Equipment—Radio Frequency Section

G. L. Stevens

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 74–80, April 15, 1976

The Precision Signal Power Measurement (PSPM) equipment has been installed at the Goldstone Mars Station, DSS 14. The PSPM equipment features a highly flexible radio frequency (RF) section providing amplification, frequency translation, filtering, sampling, and analog-to-digital conversion of the 50-MHz Block III Receiver or 55-MHz Block IV Receiver intermediate frequency signals. Remote control of gain, tuning, and filter selection permits hands-off operation of the RF section of the equipment. This article describes the RF section of the PSPM equipment.

STEWART, J. H.

S76 Discrimination of Rock Types and Detection of Hydrothermally Altered Areas in South-Central Nevada by the Use of Computer-Enhanced ERTS Images

L. C. Rowan (U.S. Geological Survey),
P. H. Wetlaufer (U.S. Geological Survey),
A. F. H. Goetz, F. C. Billingsley, and
J. H. Stewart (U.S. Geological Survey)

Geological Survey Professional Paper 883, U. S. Government Printing Office, Washington, 1976

For abstract, see Rowan, L. C.

STIRN, R. J.

S77 Practical Antireflection Coatings for Metal-Semiconductor Solar Cells

Y. C. M. Yeh, F. P. Ernest, and R. J. Stirn

J. Appl. Phys., Vol. 47, No. 9, pp. 4107–4112, September 1976

For abstract, see Yeh, Y. C. M.

STRAND, L. D.

S78 Nitramine Propellant Research

N. S. Cohen and L. D. Strand

Technical Memorandum 33-801, October 15, 1976

For abstract, see Cohen, N. S.

S79 Feasibility Demonstration of a Variable Frequency Driver- Microwave Transient Regression Rate Measurement System

L. D. Strand and R. P. McNamara

Preprint 76-105, AIAA Fourteenth Aerospace Sciences Meeting, Washington, D. C., January 26–28, 1976

The feasibility of a system capable of rapidly and directly measuring the low frequency combustion response characteristics of solid propellants has been investigated. The system consists of a variable frequency oscillatory driver device coupled with an improved version of the JPL microwave propellant regression rate measurement system. The ratio of the normalized regression rate and pressure amplitudes and their relative phase are measured as a function of varying pressure level and frequency. Test results with a well-characterized PBAN-AP propellant formulation were found to compare favorably with the results of more conventional stability measurement techniques.

STUHR, F. V.

S80 Viking Telecommunication Effects of GEOS Satellite Interference Based on Testing at the Madrid Deep Space Station

F. V. Stuhr, S. S. Kent, J. L. Galvez, B. G. Luaces, G. R. Pasero, and J. M. Urech

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 60–74, August 15, 1976

In support of the ongoing NASA–European Space Agency (ESA) effort to understand and control possible interference between missions, testing was conducted at the Madrid Deep Space Station from July 1975 to February 1976 to characterize the effect on Viking 1975 telecommunication link performance of Geodetic Earth-Orbiting Satellite (GEOS) downlink signals. The prime use of the data was to develop a capability to predict GEOS interference effects for evaluation of Viking 1975 mission impacts and possible temporary GEOS shutdown. Also, the data would serve as a basis for assessment of the GEOS impact on missions other than Viking as well as for more general interference applications. Performances of the reference receiver, telemetry, and planetary ranging were measured in the presence of various types of GEOS-related interference, including an unmodulated GEOS carrier and simulation of the actual spectrum by an ESA-supplied GEOS suitcase model. This article describes the testing performed at the Madrid Deep Space Station and the potential GEOS interference impacts on the Viking Extended Mission.

STULTZ, J. W.

S81 Solar Absorptance of Second Surface Mirrors for High Angles of Incidence

J. W. Stultz

J. Spacecraft Rockets, Vol. 13, No. 1, pp. 57–59, January 1976

Measurements have indicated an increase rather than a decrease in the solar absorptivity of second surface mirrors at angles of incidence greater than 80°. Unpublished test data by the Aerojet Electrosystem Company was the first to suggest that such a phenomenon was occurring Measurements in the Jet Propulsion Laboratory's Celestarium supported Aerojet's results. The JPL measurements were made on a second surface mirrored radiator like those currently being monitored on the Nimbus E Microwave Spectrometer experiment. These measurements were made just prior to the launch of Nimbus E and indicated that the radiator temperature would be warmer than expected, which has proved to be the case. Helios, a spin-stabilized spacecraft, has more than 50% of its sunlit surface covered with second surface mirrors. To obtain agreement between the JPL 25-ft Space Simulator test and analytical modeling required increasing the average solar absorptance from 0.09 to 0.11. These observations stimulated an analytical study which revealed that an increase should be expected. Since most applications of the mirrors have been for normal incidence angles, and since the total energy absorbed is very small at the high angles of incidence, there has been no interest in the absorptance at these angles, which perhaps explains why the increase has gone unnoticed.

TAPPAN, R. W.

T01 Antenna Pointing Subsystem Conscan Implementation

R. W. Tappan

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 88–89, August 15, 1976

The software of the computer that drives the tracking antennas in the DSN has been modified to improve the pointing accuracy for tracking operations at X-band frequencies. The change implemented an improved model for atmospheric refraction correction and added a software tracking option that corrects any remaining pointing errors. The software tracking option that was added measures the actual pointing error and corrects the antenna position accordingly. This option is discussed.

TAUSWORTHE, R. C.

T02 Standardized Development of Computer Software: Part 1. Methods

R. C. Tausworthe

Special Publication 43-29, Part 1, July 1976

This monograph describes the development of computer software methodology based on the machine-independent MBASIC language used at the Jet Propulsion Laboratory. New rules were applied to the MBASIC design and documentation standards to calibrate their effectiveness. The book includes considerable tutorial material used in graduate-level computer science classes.

T03 Simple Intuitive Models of Programming

R. C. Tausworthe

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 85–95, June 15, 1976

This article hypothesizes that mathematical models of the programming process can be formulated to gauge the sensitivities of that process to various given parameters, and that such models can be calibrated on an empirical basis and used as guides toward maximizing productivity, documentation quality, and programming reliability. The article then presents three oversimplified models as illustrations.

T04 Software Production Methodology Testbed Project

R. C. Tausworthe

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 96–106, June 15, 1976

This article reports the history and results of a 3-1/2-year study in software development methodology. The findings of this study have become the basis for DSN software development guidelines and standard practices. The article discusses accomplishments, discoveries, problems, recommendations, and future directions.

T05 Standard Random Number Generation for MBASIC

R. C. Tausworthe

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 58–62, December 15, 1976

This article presents and analyzes a machine-independent algorithm for generating pseudorandom numbers suitable for the standard MBASIC system. The algorithm used is the "polynomial congruential" or "linear recurrence modulo 2" method devised by the author in 1965. Numbers, formed as nonoverlapping, adjacent 28-bit words taken from the bit stream produced by the formula $a_{m+532} = a_{m+37} + a_m$ (modulo 2), will not repeat within the projected age of the solar system, will show no ensemble correlation, will exhibit uniform distribution of adjacent numbers up to 19 dimensions, and will not deviate from random runs-up and runs-down behavior.

T06 Standard Classifications of Software Documentation

R. C. Tausworthe

Technical Memorandum 33-756, January 15, 1976

This report describes general conceptual requirements for standard levels of documentation and for application of these requirements to intended usages. These standards encourage the policy to produce only those forms of documentation that are needed and adequate for the purpose.

Documentation standards are defined with respect to detail and format quality. Classes A through D range, in order, from the most definitive down to the least definitive, and categories 1 through 4 range, in order, from high-quality typeset down to handwritten material. Criteria for each of the classes and categories, as well as suggested selection guidelines for each, are given.

TAYLOR, D. M.

T07 Consideration of Probability of Bacterial Growth for Jovian Planets and Their Satellites

D. M. Taylor, R. M. Berkman, and N. Divine

Life Sciences and Space Research XIII, pp. 111–118, Akademie-Verlag, Berlin, 1975

Environmental parameters affecting growth of bacteria (e.g., moisture, temperature, pH, and chemical composition) were compared with current atmospheric models for Jupiter and Saturn, and with the available physical data for their satellites. Different zones of relative probability of growth were identified for Jupiter and Saturn, with the highest in pressure regions of 10^6 to 10^7 N m^{-2} (10 to 100 atmospheres) and 3×10^6 to 3×10^7 N m^{-2} (30 to 300 atmospheres), respectively. Of the more than two dozen satellites, only the largest satellites (Io, Europa, Ganymede, Callisto, and Titan) were found to be interesting biologically. Titan's atmosphere may produce a substantial greenhouse effect-providing increased surface temperatures. Models predicting a dense atmosphere are compatible with microbial growth for a range of pressures at Titan's surface. For Titan's surface the probability of growth would be enhanced if (i) the surface is entirely or partially liquid (water), (ii) volcanism (in an ice-water-steam system) is present, or (iii) access to internal heat sources is significant.

TAYLOR, F. W.

T08 Spectral Properties of Hydrogen, Helium, Methane, and Ammonia at Thermal Infrared Wavelengths

F. W. Taylor and A. D. Jones III

Icarus, Vol. 29, No. 2, pp. 299–306, October 2, 1976

We present some results of a theoretical and laboratory program to determine the thermal infrared spectral properties of the principal gaseous constituents of the atmosphere of Jupiter. G. Birnbaum has measured laboratory spectra in the 16 to 1000 μm wavelength range for hydrogen and hydrogen–helium mixtures at Jovian temperatures. These are compared to theoretically computed spectra in order to determine the temperature dependence of the line strengths in the pressure-induced rotational band and the overlap parameters from the translational band. Existing spectral data for methane do not agree well with measurements of the ν_4 band at room temperature. A revised allocation of line intensities is proposed. Existing data for the ν_2 (10 μm) band of ammonia do agree reasonably well with measurements at room temperature and at –77°C, but there are some important discrepancies which remain to be explained.

TAYLOR, H. S.

T09 Progress Report on the Use of the Many-Body Theory in Inelastic Scattering From Atoms

H. S. Taylor (University of Southern California), A. Chutjian, and L. D. Thomas (IBM Research Laboratory)

Electron and Photon Interactions With Atoms, pp. 435–444, Plenum Publishing Corp., New York, 1976

The results of the first-order many-body theory (FOMBT) are critically compared with several recent experimental studies of e–He and e–H inelastic scattering. The differential and integral cross sections calculated in the FOMBT are compared to the following measurements: differential and integral cross sections for excitation of the $2\ ^3S$, and the $n = 3$ manifold of He at energies near 30, 40, and 50 eV: electron–photon coincidence measurements in the $1\ ^1S$–$2\ ^1P$ transition in He; and integral cross sections of the $1\ ^1S \rightarrow 2\ ^1S$ and $2\ ^1P$ transitions in the H atom from threshold to 54 eV. Good agreement is found between the results of these measurements and the FOMBT. Where discrepancies exist, their pattern is noted. Where the first-order theory is lacking, several important second-order physical corrections to the first-order theory are indicated. From the above comparisons, the many-body theory results show that the important physical effects in inelastic e–atom scattering are the proper two-time model, the proper use of transition polarization, and the inclusion of the imaginary part of the second-order transition potential.

THOMAS, J. B.

T10 A Demonstration of an Independent-Station Radio Interferometry System With 4-cm Precision on a 16-km Base Line

J. B. Thomas, J. L. Fanselow, P. F. MacDoran, L. J. Skjerve, D. J. Spitzmesser, and H. F. Fliegel

J. Geophys. Res., Vol. 81, No. 5, pp. 995–1005, February 10, 1976

A series of interferometry experiments has been conducted between two antennas at the Goldstone Deep Space Communications Complex near Barstow, California. The primary objective of these experiments was to construct and demonstrate on a short base line–independent-station instrumentation capable of making three-dimensional base line measurements with accuracies of a few centimeters. To meet this objective, phase stable instrumentation was constructed to precisely measure time delay by means of two-channel bandwidth synthesis. Delay measurements produced by this instrumentation led to three-dimensional earth-fixed base line measurements with a precision (reproducibility) of 2–5 cm for the components of a 16-km base line. When this interferometry base line vector was compared with a base line vector obtained by a conventional survey, the two measurements differed by 2–15 cm in the various components. Probable causes of this vector discrepancy are discussed, with particular emphasis on the difficulties encountered in the comparison of a purely geometric interferometry base line vector with a geoid-referenced survey base line.

T11 A Demonstration of a Transportable Radio Interferometric Surveying System With 3-cm Accuracy on a 307-m Base Line

K. M. Ong, P. F. MacDoran, J. B. Thomas, H. F. Fliegel, L. J. Skjerve, D. J. Spitzmesser, P. D. Batelaan, S. R. Paine, and M. G. Newsted (Trend Western Engineering Corporation)

J. Geophys. Res., Vol. 81, No. 20, pp. 3587–3593, July 10, 1976

For abstract, see Ong, K. M.

THOMAS, L. D.

T12 Progress Report on the Use of the Many-Body Theory in Inelastic Scattering From Atoms

H. S. Taylor (University of Southern California), A. Chutjian, and L. D. Thomas (IBM Research Laboratory)

Electron and Photon Interactions With Atoms, pp. 435–444, Plenum Publishing Corp., New York, 1976

For abstract, see Taylor, H. S.

THOMPSON, T. W.

T13 Final Report: Apollo Experiment S-217 IR/Radar Study of Apollo Data

T. W. Thompson, H. J. Moore (United States Geological Survey), G. G. Schaber (United States Geological Survey), R. W. Shorthill (University of Utah), E. A. Whitaker (University of Arizona), and S. H. Zisk (NEROC Haystack Observatory)

Technical Memorandum 33-787, October 1, 1976

This is the final report on Apollo Experiment S-217, *IR and Radar Study of Apollo Data*, an experiment using Earth-based remote-sensing radar, infrared eclipse, and color-difference data to deduce surface properties not visible in Apollo photography. The Earth-based data provided information on the small-scale (centimeter-sized) blockiness and on the surface chemical composition (titanium and iron contents) of the lunar surface. These deduced surface properties complemented the new Apollo photography, leading to refined geologic interpretations of the lunar surface. Joint studies were conducted

with Apollo Experiment S-222 (Photogeology) on a number of lunar areas. Results of these joint studies appear in the open literature. The work performed under Apollo Experiment S-217 is summarized in this report.

T14 Radar Imaging of Ocean Surface Patterns

W. E. Brown, Jr., C. Elachi, and T. W. Thompson

J. Geophys. Res., Vol. 81, No. 15, pp. 2657–2667, May 20, 1976

For abstract, see Brown, W. E., Jr.

T15 Lunar Cartography With the Apollo 17 ALSE Radar Imagery

M. F. Tiernan, L. E. Roth, T. W. Thompson, C. Elachi, and W. E. Brown, Jr.

The Moon, Vol. 15, Nos. 1/2, pp. 155–163, January/February 1976

For abstract, see Tiernan, M. F.

THORNTON, C. L.

T16 A Numerical Comparison of Discrete Kalman Filtering Algorithms: An Orbit Determination Case Study

C. L. Thornton and G. J. Bierman

Technical Memorandum 33-771, June 15, 1976

The numerical stability and accuracy of various Kalman filter algorithms are thoroughly studied. Numerical results and conclusions are based on a realistic planetary approach orbit determination study. The case study results of this report highlight the numerical instability of the conventional and stabilized Kalman algorithms. Numerical errors associated with these algorithms can be so large as to obscure important mismodeling effects and thus give misleading estimates of filter accuracy. The positive result of this study is that the Bierman–Thornton U-D covariance factorization algorithm is computationally efficient, with CPU costs that differ negligibly from the conventional Kalman costs. In addition, accuracy of the U-D filter using single-precision arithmetic consistently matches the double-precision reference results. Numerical stability of the U-D filter is further demonstrated by its insensitivity to variations in the *a priori* statistics.

T17 Triangular Covariance Factorizations for Kalman Filtering

C. L. Thornton

Technical Memorandum 33-798, October 15, 1976

In this report an improved computational form of the discrete Kalman filter is derived using an upper triangular factorization of the error covariance matrix. The covariance P is factored such that $P = UDU^T$, where U is unit upper triangular and D is diagonal. Recursions are developed for propagating the U–D covariance factors together with the corresponding state estimate. The resulting algorithm, referred to as the U–D filter, combines the superior numerical precision of square root filtering techniques with an efficiency comparable to that of Kalman's original formula. Moreover, this method is easily implemented and involves no more computer storage than the Kalman algorithm. These characteristics make the U–D method an attractive real-time filtering technique.

A new covariance error analysis technique is obtained from an extension of the U–D filter equations. This evaluation method is flexible and efficient and may provide significantly improved numerical results. Cost comparisons show that for a large class of problems the U–D evaluation algorithm is noticeably less expensive than conventional error analysis methods. The U–D method is shown to be especially attractive for problems involving large numbers of bias parameters since it yields accurate and efficient techniques for performing sensitivity analysis and reduced-order filtering.

T18 Experimental Test of General Relativity Using Time-Delay Data From Mariner 6 and Mariner 7

J. D. Anderson, P. B. Esposito, W. L. Martin, C. L. Thornton, and D. O. Muhleman (California Institute of Technology)

Astrophys. J., Vol. 200, No. 1, pp. 221–233, August 15, 1975

For abstract, see Anderson, J. D.

T19 Givens Transformation Techniques for Kalman Filtering

C. L. Thornton and G. J. Bierman

Preprint IAF-76-015, Int. Astronaut. Fed. XXVII Congress, Anaheim, Calif., Oct. 10–16, 1976

This paper examines the numerical stability and accuracy of a new Kalman filtering technique. The filter algorithm is based upon square-root-free Givens transformation methods and involves an upper triangular covariance factorization $P = UDT^T$. Stability of the U–D algorithm is studied by applying this method and several other Kalman filter algorithms to a realistic orbit determination problem. This study demonstrates how the U–D filter can produce results which are orders of magnitude more accurate than those obtained with the conventional and stabilized Kalman algorithms. Computational efficiency of our algorithms is demonstrated by showing the CPU timing requirements for our U–D formulation differ negligibly from the conventional Kalman requirements.

T20 Gram-Schmidt Algorithms for Covariance Propagation

C. L. Thornton and G. J. Bierman

Proc. 1975 IEEE Conf. Decision and Control, Houston, Tex., Dec. 10–12, 1975, pp. 489–498

This paper addresses the time propagation of triangular covariance factors. Attention is focused on the square-root free factorization, $P = UDU^T$, where U is unit upper triangular and D is diagonal. An efficient and reliable algorithm for the *U-D* propagation is derived which employs Gram-Schmidt orthogonalization. Partitioning the state vector to distinguish bias and colored process noise parameters increases mapping efficiency. Cost comparisons of the *U-D*, Schmidt square-root covariance, and conventional covariance propagation methods are made using weighted arithmetic operation counts. The *U-D* time update is shown to be less costly than the Schmidt method; and, except in unusual circumstances, it is within 20% of the cost of conventional propagation.

THORPE, T. E.

T21 The Viking Orbiter Visual Imaging Subsystem

J. B. Wellman, F. P. Landauer, D. D. Norris, and T. E. Thorpe

Preprint 76-124, AIAA Fourteenth Aerospace Sciences Meeting, Washington, D. C., January 26–28, 1976

For abstract, see Wellman, J. B.

T22 The Viking Orbiter Cameras' Potential for Photometric Measurement

T. E. Thorpe

Icarus, Vol. 27, No. 2, pp. 229–239, February 1976

Although photometry of Mars is not listed as a major mission objective, the Viking Project has provided the Orbiter Imaging Team with cameras exhibiting significant improvement in photometric measurement as compared with past Mariners. Sample calibration data are described, together with predicted performance capabilities.

TIERNAN, M. F.

T23 Lunar Cartography With the Apollo 17 ALSE Radar Imagery

M. F. Tiernan, L. E. Roth, T. W. Thompson, C. Elachi, and W. E. Brown, Jr.

The Moon, Vol. 15, Nos. 1/2, pp. 155–163, January/February 1976

Lunar position differences between thirteen lunar craters in Mare Serenitatis were computed from VHF radar-imagery obtained by the Lunar Sounder instrument flown on the Apollo 17 Command Module. The radar-derived position differences agree with those obtained by conventional photogrammetric reductions of Apollo metric photography. This demonstrates the feasibility of using the Apollo Lunar Sounder data to determine the positions of lunar features along the Apollo 17 orbital tracks. This will be particularly useful for western limb and farside areas, where no Apollo metric camera pictures are available.

TOTH, L. R.

T24 Propellant/Material Compatibility Program and Results

L. R. Toth, W. A. Cannon, C. D. Coulbert, and H. R. Long

Technical Memorandum 33-779, August 15, 1976

This report gives the analyses and results of a program to establish the effects of long-term (up to 10 years) contact of inert materials with earth-storable propellants for the purpose of designing chemical propulsion system components that can be used for current as well as future planetary spacecraft. Phase I, which was concluded in 1967, was a pilot-type effort to evaluate a limited number of materials. Phase II is the primary experimental work, and results to date are reported herein. Investigations include the following propellants: hydrazine, hydrazine–hydrazine nitrate blends, monomethylhydrazine, and nitrogen tetroxide. Materials include: aluminum alloys, corrosion-resistant steels, and titanium alloys. More than 700 test specimen capsules were placed in long-term storage testing at 43°C (110°F) in the special material compatibility facility located at JPL Edwards Test Station, Calif. Material ratings relative to the 10-year requirement have been assigned.

TOUKDARIAN, R. Z.

T25 Final Engineering Report for Goldstone Operations Support Radar

R. Z. Toukdarian

Technical Memorandum 33-800, November 1, 1976

The Tracking and Data Acquisition Office at the Jet Propulsion Laboratory committed to the National Aeronautics and Space Administration Office of Tracking and Data Acquisition the earliest possible operational capability date for the Goldstone Operations Support Radar program. The Deep Space Network requested to under-

take the planning, engineering, and installation, as required. The type of radar selected to meet the requirements was an AN/FPS-18. A project was established for the procurement and refurbishment of surplus equipment, assembly on site, and demonstration, as well as coordination with a separate architect and engineering company on related facilities planning and with the facility construction contractor. The implementation, testing, demonstration, operation, maintenance and evaluation of the equipment are discussed.

TRAJMAR, S.

T26 Absolute Elastic Differential Electron Scattering Cross Sections in the Intermediate Energy Region. II.—N_2

S. K. Srivastava, A. Chutjian, and S. Trajmar

J. Chem. Phys., Vol. 64, No. 4, pp. 1340–1344, February 15, 1976

For abstract, see Srivastava, S. K.

T27 Absolute Elastic Differential Electron Scattering Cross Sections in the Intermediate Energy Region. III. SF_6 and UF_6

S. K. Srivastava, S. Trajmar, A. Chutjian, and W. Williams

J. Chem. Phys., Vol. 64, No. 7, pp. 2767–2771, April 1, 1976

For abstract, see Srivastava, S. K.

T28 Differential Elastic Cross Sections for High Angle Electron Scattering by He in the Intermediate Energy Region

S. K. Srivastava and S. Trajmar

J. Chem. Phys., Vol. 64, No. 9, pp. 3886–3888, May 1, 1976

For abstract, see Srivastava, S. K.

T29 Electron-Impact Excitation of UF_6 at an Electron Energy of 20 eV in the Energy-Loss Range of 0–10 eV

A. Chutjian, S. K. Srivastava, S. Trajmar, W. Williams, and D. C. Cartwright (Los Alamos Scientific Laboratory)

J. Chem. Phys., Vol. 64, No. 11, pp. 4791–4793, June 1, 1976

For abstract, see Chutjian, A.

T30 Photoabsorption Spectrum of UF_6 by Electron Impact

S. K. Srivastava, D. C. Cartwright (Los Alamos Scientific Laboratory), S. Trajmar, A. Chutjian, and W. Williams

J. Chem. Phys., Vol. 65, No. 1, pp. 208–211, July 1, 1976

For abstract, see Srivastava, S. K.

T31 Electron Scattering From Li at 5.4, 10, 20 and 60 eV Impact Energies

W. Williams S. Trajmar, and D. G. Bozinis (Universidade de Estadual, Campinas, Brazil)

J. Phys. B: At. Mol. Phys., Vol. 9, No. 9, pp. 1529–1536, June 21, 1976

For abstract, see Williams, W.

T32 Electron Scattering by Highly Polar Molecules. I. KI

M. R. H. Rudge, S. Trajmar, and W. Williams

Phys. Rev., Pt. A: Gen. Phys., Vol. 13, No. 6, pp. 2074–2086, June 1976

For abstract, see Rudge, M. R. H.

TRASK, D. W.

T33 Gravity Fields

W. L. Sjogren, J. D. Anderson, R. J. Phillips, and D. W. Trask

IEEE Trans. Geosci. Electron., Vol. GE-14, No. 3, pp. 172–183, July 1976

For abstract, see Sjogren, W. L.

TRAXLER, M. R.

T34 Tracking and Data Systems Support for the Helios Project: Project Development Through End of Mission Phase II

P. S. Goodwin, M. R. Traxler, W. G. Meeks, and F. M. Flanagan

Technical Memorandum 33-752, Vol. I, July 1, 1976

For abstract, see Goodwin, P. S.

TROMBKA, J. I.

T35 Preliminary Design and Performance of an Advanced Gamma-Ray Spectrometer for Future Orbiter Missions

A. E. Metzger, R. H. Parker,
J. R. Arnold (University of California, San Diego),
R. C. Reedy (Los Alamos Scientific Laboratory),
and J. I. Trombka (Goddard Space Flight Center)

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 2769–2784, 1975

For abstract, see Metzger, A. E.

TRUONG, T. K.

T36 The Fast Decoding of Reed–Solomon Codes Using Number Theoretic Transforms

I. S. Reed (University of Southern California),
L. R. Welch (University of Southern California),
and T. K. Truong

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 64–78, October 15, 1976

For abstract, see Reed, I. S.

T37 The Fast Decoding of Reed–Solomon Codes Using Fermat Theoretic Transforms and Continued Fractions

L. R. Welch (University of Southern California),
I. S. Reed (University of Southern California), and
T. K. Truong

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 63–74, December 15, 1976

For abstract, see Welch, L. R.

T38 The Fast Decoding of Reed–Solomon Codes Using High-Radix Fermat Theoretic Transforms

K. Y. Liu (University of Southern California),
I. S. Reed (University of Southern California), and
T. K. Truong

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 75–80, December 15, 1976

For abstract, see Liu, K. Y.

TSURUTANI, B. T.

T39 Energetic Particles of the Outer Regions of Planetary Magnetospheres

B. T. Tsurutani, B. E. Goldstein, and A. Bratenahl

Technical Memorandum 33-766, March 1, 1976

High energy particles, with energies above those attainable by adiabatic or steady-state electric field acceleration, have been observed in and around the outer regions of planetary magnetospheres. Acceleration by large amplitude sporadic cross-tail electric fields over an order of magnitude greater than steady-state convection fields is proposed as a source of these particles. It is suggested that such explosive electric fields will occur intermittently in the vicinity of the tail neutral line in the expansive phases of substorms. Laboratory and satellite evidences are used to estimate this electric potential for substorms at earth; values of 500 kilovolts to 2 megavolts are calculated, in agreement with particle observations. It is further suggested that these particles, which have been accelerated in the nightside magnetosphere, drift to the dayside on closed field lines, and under certain interplanetary conditions can escape to regions upstream of the bow shock.

T40 Properties of ELF Electromagnetic Waves in and Above the Earth's Ionosphere Deduced From Plasma Wave Experiments on the OV1-17 and OGO 6 Satellites

M. C. Kelley (Cornell University),
B. T. Tsurutani, and F. S. Mozer (University of California, Berkeley)

J. Geophys. Res., Space Phys., Vol. 80, No. 34, pp. 4603–4611, December 1, 1975

For abstract, see Kelley, M. C.

T41 Jovian Electron Bursts: Correlation With the Interplanetary Field Direction and Hydromagnetic Waves

E. J. Smith, B. T. Tsurutani,
D. L. Chenette (University of Chicago),
T. F. Conlon (University of Chicago), and
J. A. Simpson (University of Chicago)

J. Geophys. Res., Space Phys., Vol. 81, No. 1, pp. 65–72, January 1, 1976

For abstract, see Smith, E. J.

T42 Magnetosheath Lion Roars

E. J. Smith and B. T. Tsurutani

J. Geophys. Res., Space Phys., Vol. 81, No. 13, pp. 2261–2266, May 1, 1976

For abstract, see Smith, E. J.

UCHIYAMA, A. A.

U01 Impedance of Silver Oxide-Zinc Cells

H. A. Frank, W. L. Long, and A. A. Uchiyama

J. Electrochem. Soc., Vol. 123, No. 1, pp. 1–9, January 1976

For abstract, see Frank, H. A.

UNTI, T.

U02 On the Causes of Spectral Enhancements in Solar Wind Power Spectra

T. Unti and C. T. Russell (University of California, Los Angeles)

J. Geophys. Res., Space Phys., Vol. 81, No. 4, pp. 469–482, February 1, 1976

Enhancements in power spectra of solar wind ion flux in the frequency neighborhood of 0.5 Hz had been noted by Unti et al. (1973). It was speculated that these were due to convected small-scale density irregularities. In this paper we examine 54 flux spectra, calculated from Ogo 5 data. It is seen that the few prominent spectral peaks which occur were not generated by density irregularities but were due to several different causes, including convected discontinuities and propagating transverse waves. A superposition of many spectra, however, reveals a moderate enhancement at a frequency corresponding to convected features with a correlation length of a proton gyroradius, consistent with the results of Neugebauer (1975).

URECH, J. M.

U03 Preliminary Results of DSN Performance for Convolutional Codes With a Viterbi Decoder

J. M. Urech, L. D. Vit, and B. D. L. Mulhall

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 222–240, April 15, 1976

To determine DSN Telemetry System performance when maximum-liklihood convolutional decoding is employed, testing is being undertaken at DSS 62, Madrid, Spain. Testing hardware and software have been developed to evaluate the performance of the DSN in the Viterbi mode with the LV7015 model. Since the bit errors at the decoder output occur in bursts, the test program includes a series of statistical analyses in runs of correct bits and burst of bits in error.

U04 DSN Performance Tests of a Maximum Likelihood Decoder

J. M. Urech, L. D. Vit, and C. A. Greenhall

The Deep Space Network: March and April 1976, DSN Progress Report 42-33, pp. 131–146, June 15, 1976

Viterbi decoding tests were carried out at DSS 62, Madrid, Spain. Results of bit error rate, burst statistics, and estimation of signal-to-noise ratio are presented.

U05 Viking Telecommunication Effects of GEOS Satellite Interference Based on Testing at the Madrid Deep Space Station

F. V. Stuhr, S. S. Kent, J. L. Galvez, B. G. Luaces, G. R. Pasero, and J. M. Urech

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 60–74, August 15, 1976

For abstract, see Stuhr, F. V.

VAN ALLEN, R. E.

V01 Mariner Jupiter/Saturn 1977 Navigation strategy

E. L. McKinley and R. E. Van Allen

J. Spacecraft Rockets, Vol. 13, No. 8, pp. 494–501, August 1976

For abstract, see McKinley, E. L.

VAN BUREN, R.

V02 The Levels of Edit

R. Van Buren and M. F. Buehler

Special Publication 43-28, March 1976

The editorial process is analyzed, and five levels of edit are identified. These levels represent cumulative combinations of nine types of edit: Coordination, Policy, Integrity, Screening, Copy Clarification, Format, Mechanical Style, Language, and Substantive. The levels and types of edit, although developed for specific use with external reports at the Jet Propulsion Laboratory, cover the general range of technical editing, especially as it applies to an in-house technical publications organization. Each type of edit is set forth in terms of groups of actions to be performed by the editor.

The edit-level concept has enhanced understanding and communication among editors, authors, and publications managers concerning the specific editorial work to be done on each manuscript. It has also proved useful as a management tool for estimating and monitoring cost.

VAN LINT, V. A. J.

V03 Correlation of Displacement Effects Produced by Electrons, Protons, and Neutrons in Silicon

V. A. J. van Lint, G. Gigas, and J. B. Barengoltz

IEEE Trans. Nucl. Sci., Vol. NS-22, No. 6, pp. 2663–2668, December 1975

The correlation of displacement effects produced by electrons, protons, and neutrons in silicon is studied. Available data from the literature is employed. In particular the scope of the study is limited to the degradation of excess carrier lifetime and device electrical parameters directly related to it. The degree to which displacement effects may be correlated in order to predict semiconductor device response based on response data to another type of radiation is discussed. Useful ranges of the correlation factors as a function of device majority carrier type, device resistivity, and injection level are presented. A significant dependence on injection level for the correlation factors is found.

VARSI, G.

V04 Blast Wave in a Nozzle for Propulsive Applications

G. Varsi, L. H. Back, and K. Kim

Acta Astronautica, Vol. 3, Nos. 1/2, pp. 141–156, January/February 1976

An attractive way to overcome the limitations of conventional solid or liquid rocket motors operating in a high pressure environment (such as the atmospheres of the major planets) is to use detonating propellant. The limitations arise out of the need to use low expansion ratios and therefore low specific thrusts in order to avoid an excessive structural mass, rapidly increasing with the ambient pressure. A detonating propellant, however, achieves very high expansion ratios in a pulsed operation, and, therefore, it does not require as massive a structure to contain the pressures statically. To understand the functioning of such a rocket and to determine its performance parameters, one- and two-dimensional calculations, as well as a series of experiments, have been performed for a single detonation. This paper presents measurements of pressures ranging up to 69 bar. These data, together with fast cinematographic information, are compared with numerical hydrodynamic calculations in the usual approximation of inviscid flow. While the experimental reproducibility of the impulse measurements is good, there are some variations in the flow field from firing to firing. Overall, the flow is fairly symmetric, and the pressure field is represented adequately by a one-dimensional calculation up to the time when the shock exits the nozzle while the velocity field shows significant dependence on the radial coordinate. Indications of an early oscillatory behavior at high ambient pressure are presented together with the effects of varying the molecular weight of the ambient gas from 28 (nitrogen) to 4 (helium).

V05 Measurement of Detonation Propulsion in Helium and Performance Calculations

K. Kim, L. H. Back, and G. Varsi

AIAA J., Vol. 14, No. 3, pp. 310–312, March 1976

For abstract, see Kim, K.

VASUDEVAN, R.

V06 A New Approach to Radiative Transfer Theory Using Jones's Vectors

A. L. Fymat and R. Vasudevan (University of Southern California)

Astrophys. Space Sci., Vol. 38, No. 1, pp. 95–124, November 1975

For abstract, see Fymat, A. L.

VAUGHAN, R. W.

V07 Extraction of Quadrature Phase Information From Multiple Pulse NMR Signals

W. K. Rhim, D. P. Burum (California Institute of Technology), and R. W. Vaughan (California Institute of Technology)

Rev. Sci. Instrum., Vol. 47, No. 6, pp. 720–725, June 1976

For abstract, see Rhim, W. K.

VEEDER, G. J.

V08 Photometry of 433 Eros From 0.65 to 2.2 μm

G. J. Veeder, D. L. Matson, J. T. Bergstralh, and T. V. Johnson

Icarus, Vol. 28, No. 1, pp. 79–85, May 1976

Lightcurves of 433 Eros are reported for 11 bandpasses ranging from 0.65 to 2.2 μm in wavelength. The relative spectral reflectance, $R(\lambda)$, was not seen to vary during our observations. Eros has $R(1.6\ \mu\text{m}) = 1.5 \pm 0.1$ and $R(2.2\ \mu\text{m}) = 1.7 \pm 0.1$, where $R(\lambda)$ is the spectral reflectance scaled to unity at $\lambda = 0.56\ \mu$m. This spectral reflectance is suggestive of a mixture of silicates and material with high infrared reflectance, perhaps a metallic phase such as meteoritic "iron."

W04 **Viking 1 Planetary Phase Tracking Operations: Mars Orbit Insertion Through Landing**

A. L. Berman and J. A. Wackley

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 148–170, October 15, 1976

For abstract, see Berman, A. L.

W05 **The 1976 Helios and Pioneer Solar Conjunctions—Continuing Corroboration of the Link Between Doppler Noise and Integrated Signal Path Electron Density**

A. L. Berman, J. A. Wackley, and S. T. Rockwell

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 121–137, December 15, 1976

For abstract, see Berman, A. L.

WADA, B. K.

W06 **Modal Test: Measurement and Analysis Requirements**

B. K. Wada

Paper 751066, SAE National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov. 17–20, 1975

Analysis of modal test data prior to dismantlement of the test setup is required to assure high quality data. Often erroneous or incomplete data, which are detected after the test, seriously compromise the value of the test itself. With the advent of minicomputers for modal testing to reduce the test duration, a larger burden exists on rapid data analysis to support the test. The experiences at the Jet Propulsion Laboratory in data analysis and its presentation are described. Data analysis results from the Viking Orbiter Program are used to illustrate the analysis and its presentation.

WAHLQUIST, H. D.

W07 **Response of Doppler Spacecraft Tracking to Gravitational Radiation**

F. B. Estabrook and H. D. Wahlquist

Gen. Relat. Grav., Vol. 6, No. 5, pp. 439–447, October 1975

For abstract, see Estabrook, F. B.

W08 **Prolongation Structures of Nonlinear Evolution Equations. II**

F. B. Estabrook and H. D. Wahlquist

J. Math. Phys. (N. Y.), Vol. 17, No. 7, pp. 1293–1297, July 1976

For abstract, see Estabrook, F. B.

WALL, R. J.

W09 **Computer-Assisted Karyotyping**

K. R. Castleman, J. Melnyk (City of Hope National Medical Center), H. J. Frieden, G. W. Persinger (City of Hope National Medical Center), and R. J. Wall

J. Reproductive Med., Vol. 17, No. 1, pp. 53–57, July 1976

For abstract, see Castleman, K. R.

WALLACE, S.

W10 **Functional Polymeric Microspheres Based on 2-Hydroxyethyl Methacrylate for Immunochemical Studies**

A. Rembaum, S. P. S. Yen, E. Cheong, S. Wallace, R. S. Molday (California Institute of Technology), I. L. Gordon (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

Macromolecules, Vol. 9, No. 2, pp. 328–336, March–April 1976

For abstract, see Rembaum, A.

WALLIS, D. E.

W11 **Two Methods for Reducing the Number of Multiplications in Complex Fast Fourier Transforms**

D. E. Wallis

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 123–138, April 15, 1976

Computational savings in hardware and software mechanizations of the Fast Fourier Transform (FFT) can be obtained by two methods: the first method, generalizable for N a power of 2, exploits the intrinsic simplicity of multiplication by j (unit imaginary), in addition to the periodicity and half-period negation identities usually employed. The second method, outlined for the case $N = 16$ only, exploits the quadrantal symmetries of the real cosine and sine functions in an implementation of the complex FFT which uses only real multiplications. The first method requires $N/2 \log_2 N/8 + 2$ nontrivial complex multiplications, or 10 complex multiplications at N

= 16. The second method requires only 12 real-coefficient multiplications $N = 16$ to achieve the same result, but a generalization to higher N is not presently known.

WARD, R. S.

W12 Shuttle Experiment Pointing Mount (EPM) Systems

E. Mettler, E. L. Marsh, R. S. Ward, and T. Assefi

Preprint 76-964, AIAA Conf. Syst. Design Driven by Sensors, Pasadena, Calif., Oct. 18–20, 1976

For abstract, see Mettler, E.

WARDLE, M. D.

W13 Bactericidal Effect of Hydrogen Peroxide on Spacecraft Isolates

M. D. Wardle and G. M. Renninger (Bionetics Corporation)

Appl. Microbiol., Vol. 30, No. 4, pp. 710–711, October 1975

Solutions of 3, 10, and 15% hydrogen peroxide were found to have pronounced bactericidal effects, as a function of time of exposure, on sporeformers and nonsporeformers isolated from spacecraft.

WATERS, J. W.

W14 Venus: Microwave Detection of Carbon Monoxide

R. K. Kakar, J. W. Waters, and W. J. Wilson (Aerospace Corporation)

Science, Vol. 191, No. 4225, pp. 379–380, January 30, 1976

For abstract, see Kakar, R. K.

W15 Microwave Measurement of Mesospheric Carbon Monoxide

J. W. Waters, W. J. Wilson (Aerospace Corporation), and F. I. Shimabukuro (Aerospace Corporation)

Science, Vol. 191, No. 4232, pp. 1174–1175, March 19, 1976

Ground-based observation of atmospheric absorption of solar radiation at a wavelength of 2.6 millimeters has provided the first measurement of mesospheric carbon monoxide. The measurement agrees with photochemical predictions of a carbon monoxide source in the lower thermosphere due to dissociation of carbon dioxide by solar radiation, and has implications for the magnitude of vertical transport in the mesosphere.

W16 Microwave Remote Sensing of Atmospheric Temperatures From the Nimbus 5 Satellite

J. W. Waters, D. H. Staelin (Massachusetts Institute of Technology), K. F. Kunzi (Massachusetts Institute of Technology), R. L. Pettyjohn (Massachusetts Institute of Technology), and R. K. L. Poon (Massachusetts Institute of Technology)

Space Research XV, pp. 117–121, Akademie-Verlag, Berlin, 1975

Results from the Nimbus 5 Microwave Spectrometer Experiment have demonstrated the ability of passive microwave measurements from orbit to sense the atmospheric temperature profile with rms errors averaged over all weather and surface conditions of ~2K over most of the troposphere.

WEBER, W. J., III

W17 Viking X-Band Telemetry Experiment Final Report

W. J. Weber III, W. E. Ackerknecht III, and F. J. Kollar

Technical Memorandum 33-794, September 1, 1976

In 1977 Mariner Jupiter-Saturn (MJS) will be the first interplanetary spacecraft to use X-band frequencies for telemetry. To uncover operational and design problems in the use of X-band by MJS and future spacecraft using the Deep Space Network, an X-band telemetry experiment was conceived in 1973 and conducted in 1974 using the Mariner Venus-Mercury spacecraft. The Viking X-band telemetry experiment is a continuation of this earlier experiment with similar goals and expanded objectives. The experiment was conducted at DSS 14 during the months of December 1975 and January 1976. During each of the five successful passes, a periodic sequence (in lieu of ranging) was transmitted to the spacecraft and returned by the spacecraft transponder on both S- and X-bands. These telemetry-like signals were received, demodulated, and detected. From a variety of measurements at the station, four independent measurements were made of the received signal-to-noise ratio (SNR). These four SNRs were later compared with each other and the predicted SNR. The principal result of the experiment is that X-band telemetry works as expected.

W18 Performance of Phase-Locked Loops in the Presence of Fading Communication Channels

W. J. Weber III

IEEE Trans. Commun., Vol. COM-24, No. 5, pp. 487–499, May 1976

An approach is presented for the analysis of phase-locked loops whose input signal has passed through time-varying channels. The specific channels considered in detail are the Rice–Nakagami, Rayleigh, and lognormal fading channels. Loop performance is characterized in terms of the steady-state probability density function of the reduced phase error process. The basic parameters which characterize performance include the loop signal-to-noise ratio and the variance and bandwidth of the fading components introduced by the channel. Particular channel models are used to illustrate the theory for the first-order loop. The results are also applied to the analysis of the PSK noisy reference problem in the presence of these time-varying channels.

WEBSTER, L.

W19 Maximum Likelihood Convolutional Decoding (MCD) Performance Due to System Losses

L. Webster

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 108–118, August 15, 1976

A model for predicting the computational performance of a maximum likelihood convolutional decoder (MCD) operating in a noisy carrier reference environment is described. This model is used to develop a subroutine that will be utilized by the Telemetry Analysis Program to compute the MCD bit error rate. When this computational model is averaged over noisy reference phase errors using a high-rate interpolation scheme, the results are found to agree quite favorably with experimental measurements

WEEKS, W. F.

W20 Imaging Radar Observations of Frozen Arctic Lakes

C. Elachi, M. L. Bryan, and W. F. Weeks (Cold Regions Research and Engineering Laboratory)

Remote Sensing Environ., Vol. 5, No. 3, pp. 169–175, 1976

For abstract, see Elachi, C.

WEISS, J. R.

W21 Thorium–Uranium Fission Radiography

E. L. Haines, J. R. Weiss, D. S. Burnett (California Institute of Technology), and D. S. Woolum (California Institute of Technology)

Nucl. Instrum. Methods, Vol. 135, No. 1, pp. 125–131, May 15, 1976

For abstract, see Haines, E. L.

W22 The Fission Track Record of Apennine Front KREEP Basalts

E. L. Haines, I. D. Hutcheon (University of California, Berkeley), and J. R. Weiss

Proc. Sixth Lunar Sci. Conf. (Suppl. 6, *Geochim. Cosmochim. Acta*), pp. 3527–3540, 1975

For abstract, see Haines, E. L.

WELCH, L. R.

W23 The Fast Decoding of Reed–Solomon Codes Using Number Theoretic Transforms

I. S. Reed (University of Southern California), L. R. Welch (University of Southern California), and T. K. Truong

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 64–78, October 15, 1976

For abstract, see Reed, I. S.

W24 The Fast Decoding of Reed–Solomon Codes Using Fermat Theoretic Transforms and Continued Fractions

L. R. Welch (University of Southern California), I. S. Reed (University of Southern California), and T. K. Truong

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 63–74, December 15, 1976

It is shown that Reed–Solomon (RS) codes can be decoded by using a fast Fourier transform algorithm over finite fields $GF(F_n)$, where F_n is a Fermat prime, and continued fractions. This new transform decoding method is simpler than the standard method for RS codes. The computing time of this new decoding algorithm in software can be faster than the standard decoding method for RS codes.

WELLMAN, J. B.

W25 The Viking Orbiter Visual Imaging Subsystem

J. B. Wellman, F. P. Landauer, D. D. Norris, and T. E. Thorpe

Preprint 76-124, AIAA Fourteenth Aerospace Sciences Meeting, Washington, D. C., January 26–28, 1976

Two Viking spacecraft each consisting of an Orbiter and a Lander are on trajectories toward Mars with arrival dates in June and August 1976. A Visual Imaging Subsystem, consisting of two slow-scan television cameras, forms part of the scientific payload of each Orbiter. These cameras will be used to evaluate the potential landing sites on Mars and to conduct other scientific investigations of the planet. The camera system described in this paper was subjected to an extensive test and calibration program prior to launch. Based on this calibration and subsequent analyses, absolute photometric accuracies of 8.0% may be achieved. Surface resolution exceeding 100 meters will be achieved from the periapsis portion of the Viking orbits. The inherent geometric accuracies of the Orbiter cameras supersede those of previous planetary missions. The analyses of images acquired during the cruise phase of the mission confirm that the cameras have survived the rigors of launch and are performing in a manner consistent with prelaunch calibrations.

WENDELL, P.

W26 A System for the Direct Digitization of Electron Images From a TEM

R. E. Hartman, H. Alsberg, R. S. Hartman, R. Nathan, and P. Wendell

Proc. Eighth Int. Congress Electron Microscop., Canberra, 1974, Vol. I, pp. 96–97

For abstract, see Hartman, R. E.

WETLAUFER, P. H.

W27 Discrimination of Rock Types and Detection of Hydrothermally Altered Areas in South-Central Nevada by the Use of Computer-Enhanced ERTS Images

L. C. Rowan (U.S. Geological Survey), P. H. Wetlaufer (U.S. Geological Survey), A. F. H. Goetz, F. C. Billingsley, and J. H. Stewart (U.S. Geological Survey)

Geological Survey Professional Paper 883, U. S. Government Printing Office, Washington, 1976

For abstract, see Rowan, L. C.

WHITAKER, E. A.

W28 Final Report: Apollo Experiment S-217 IR/Radar Study of Apollo Data

T. W. Thompson, H. J. Moore (United States Geological Survey), G. G. Schaber (United States Geological Survey), R. W. Shorthill (University of Utah), E. A. Whitaker (University of Arizona), and S. H. Zisk (NEROC Haystack Observatory)

Technical Memorandum 33-787, October 1, 1976

For abstract, see Thompson, T. W.

WILCHER, J. H.

W29 A New Sequential Decoder for the DSN Telemetry Subsystem

J. H. Wilcher

The Deep Space Network: May and June 1976, DSN Progress Report 42-34, pp. 84–87, August 15, 1976

A new sequential decoder has been implemented in the DSS Telemetry Subsystem for the DSN MARK III Data System Implementation. This decoder performs the same decoding function as the Data Decoder Assembly performs in the Telemetry and Command Data Handling Subsystem. However, the new decoder is much faster, allowing potentially high data rates in the future.

WILLIAMS, J. G.

W30 New Test of the Equivalence Principle From Lunar Laser Ranging

J. G. Williams, et al.

Phys. Rev. Lett., Vol. 36, No. 11, pp. 551–554, March 15, 1976

An analysis of six years of lunar-laser-ranging data gives a zero amplitude for the Nordtvedt term in the Earth–Moon distance yielding the Nordtvedt parameter $\eta = 0.00 \pm 0.03$. Thus, Earth's gravitational self-energy contributes equally, ±3%, to its inertial mass and passive gravitational mass. At the 70% confidence level this result is only consistent with the Brans–Dicke theory for $\omega > 29$. We obtain $|\beta - 1| \lesssim 0.02$ to 0.05 for five-parameter parametrized post-Newtonian theories of gravitation with energy-momentum conservation, or $|\beta - 1| \lesssim 0.01$ if only β and γ are considered.

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University of Texas: J. D. Mulholland, P. J. Shelus, and E. C. Silverberg

Goddard Space Flight Center: H. H. Plotkin

WILLIAMS, W.

W31 Absolute Elastic Differential Electron Scattering Cross Sections in the Intermediate Energy Region. III. SF_6 and UF_6

S. K. Srivastava, S. Trajmar, A. Chutjian, and W. Williams

J. Chem. Phys., Vol. 64, No. 7, pp. 2767–2771, April 1, 1976

For abstract, see Srivastava, S. K.

W32 Electron-Impact Excitation of UF_6 at an Electron Energy of 20 eV in the Energy-Loss Range of 0–10 eV

A. Chutjian, S. K. Srivastava, S. Trajmar, W. Williams, and D. C. Cartwright (Los Alamos Scientific Laboratory)

J. Chem. Phys., Vol. 64, No. 11, pp. 4791–4793, June 1, 1976

For abstract, see Chutjian, A

W33 Photoabsorption Spectrum of UF_6 by Electron Impact

S. K. Srivastava, D. C. Cartwright (Los Alamos Scientific Laboratory), S. Trajmar, A. Chutjian, and W. Williams

J. Chem. Phys., Vol. 65, No. 1, pp. 208–211, July 1, 1976

For abstract, see Srivastava, S. K.

W34 Electron Scattering From Li at 5.4, 10, 20 and 60 eV Impact Energies

W. Williams S. Trajmar, and D. G. Bozinis (Universidade de Estadual, Campinas, Brazil)

J. Phys. B: At. Mol. Phys., Vol. 9, No. 9, pp. 1529–1536, June 21, 1976

Differential and integral cross sections for elastic scattering and for the excitation of the 2p ^{2}P, 3p, ^{2}P, 4p ^{2}P and 3s ^{2}S states of lithium have been determined and elastic momentum transfer cross sections have been obtained at 5.4, 10, 20 and 60 eV electron impact energies. The cross-sections were normalized to the absolute scale by using the total cross-section measurements of Kasdan *et al.* The integral elastic scattering cross sections have been compared to calculations utilizing the Glauber and Born approximations and the 2p ^{2}P integral cross-section results have been compared with optical excitation function measurements and with close-coupling calculations.

W35 Electron Scattering by Highly Polar Molecules. I. KI

M. R. H. Rudge, S. Trajmar, and W. Williams

Phys. Rev., Pt. A: Gen. Phys., Vol. 13, No. 6, pp. 2074–2086, June 1976

For abstract, see Rudge, M. R. H.

WILSON, A. H.

W36 Modular Disposable Can (MODCAN) Crash Cushion: A Concept Investigation

A. C. Knoell and A. H. Wilson

Technical Memorandum 33-795, August 15, 1976

For abstract, see Knoell, A. C.

WILSON, W. J.

W37 Venus: Microwave Detection of Carbon Monoxide

R. K. Kakar, J. W. Waters, and W. J. Wilson (Aerospace Corporation)

Science, Vol. 191, No. 4225, pp. 379–380, January 30, 1976

For abstract, see Kakar, R. K.

W38 Microwave Measurement of Mesospheric Carbon Monoxide

J. W. Waters, W. J. Wilson (Aerospace Corporation), and F. I. Shimabukuro (Aerospace Corporation)

Science, Vol. 191, No. 4232, pp. 1174–1175, March 19, 1976

For abstract, see Waters, J. W.

WINN, F. B.

W39 Atmospheric Water Vapor Calibrations: Radiometer Technique

F. B. Winn, S. C. Wu, G. M. Resch, C. C. Chao, O. H. von Roos, and H. S. Lau (Stanford University)

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 38–49, April 15, 1976

A radiometric technique for determining atmospheric water vapor effects on radiometric range and doppler has been partially evaluated. Empirical test results indicate that the microwave thermal emission from water vapor at 22.2- and 31.4-GHz frequencies can yield line-of-sight electrical phase path calibrations to the centimeter accuracy level.

WINN, G. H.

W40 Compatibility Test System for Use With the Mark III DSN Data Subsystems Implementation

A. I. Bryan and G. H. Winn

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 5–8, February 15, 1976

For abstract, see Bryan, A. I.

WITTIG, C.

W41 Electric-Discharge-Pumped Nitrogen Ion Laser

J. B. Laudenslager, T. J. Pacala, and C. Wittig (University of Southern California)

Appl. Phys. Lett., Vol. 29, No. 9, pp. 580–582, November 1, 1976

For abstract, see Laudenslager, J. B.

WOICESHYN, P. M.

W42 Temperature of the Atmosphere of Jupiter From Pioneer 10/11 Radio Occultations

A. J. Kliore, P. M. Woiceshyn, and W. B. Hubbard (University of Arizona)

Geophys. Res. Lett., Vol. 3, No. 3, pp. 113–116, March 1976

For abstract, see Kliore, A. J.

WOLFE, J. H.

W43 Observations of Interaction Regions and Corotating Shocks Between One and Five AU: Pioneers 10 and 11

E. J. Smith and J. H. Wolfe (Ames Research Center)

Geophys. Res. Lett., Vol. 3, No. 3, pp. 137–140, March 1976

For abstract, see Smith, E. J.

WOO, R.

W44 Measurements of Electron Density Irregularities in the Ionosphere of Jupiter by Pioneer 10

R. Woo and F. C. Yang

J. Geophys. Res., Space Phys., Vol. 81, No. 19, pp. 3417–3422, July 1, 1976

In this paper we demonstrate that when the frequency spectrum of the log amplitude fluctuations is used, the radio occultation experiment is a powerful tool for detecting, identifying, and studying ionospheric irregularities. Analysis of the Pioneer 10 radio occultation measurements reveals that the Jovian ionosphere possesses electron density irregularities which are very similar to those found in the earth's ionosphere. This is the first time such irregularities have been found in a planetary ionosphere other than that of the earth. The Pioneer 10 results indicate that the spatial wave number spectrum of the electron density irregularities is close to the Kolmogorov spectrum and that the outer scale size is greater than the Fresnel size (6.15 km). This type of spectrum suggests that the irregularities are probably produced by the turbulent dissipation of irregularities larger than the outer scale size.

WOOD, L. J.

W45 Statistical Analysis of Trim Maneuvers in Low-Thrust Interplanetary Navigation

G. C. Rinker, R. A. Jacobson, and L. J. Wood (Hughes Aircraft Company)

J. Spacecraft Rockets, Vol. 13, No. 8, pp.509–512, August 1976

For abstract, see Rinker, G. C.

WOOLUM, D. S.

W46 Thorium–Uranium Fission Radiography

E. L. Haines, J. R. Weiss, D. S. Burnett (California Institute of Technology), and D. S. Woolum (California Institute of Technology)

Nucl. Instrum. Methods, Vol. 135, No. 1, pp. 125–131, May 15, 1976

For abstract, see Haines, E. L.

WU, S. C.

W47 Atmospheric Water Vapor Calibrations: Radiometer Technique

F. B. Winn, S. C. Wu, G. M. Resch, C. C. Chao, O. H. von Roos, and H. S. Lau (Stanford University)

The Deep Space Network: January and February 1976, DSN Progress Report 42-32, pp. 38–49, April 15, 1976

For abstract, see Winn, F. B.

YAKIMOVSKY, Y.

Y01 Nondeterministic Data Base for Computerized Visual Perception

Y. Yakimovsky

Technical Memorandum 33-761, February 1, 1976

A description is given of the knowledge representation data base in the perception subsystem of the Mars robot vehicle prototype being implemented at JPL. Two types of information are stored. The first is generic information that represents general rules that are conformed to by structures in the expected environments. The second kind of information is a specific description of a structure, i.e., the properties and relations of objects in the specific case being analyzed. This paper is limited in scope to the description of the syntax and semantics of the data structure. The generic knowledge is represented so that it can be applied to extract and infer the description of specific structures. The use of the generic model in the inference process is only briefly described where needed to justify the generic knowledge representation, and it will be thoroughly described in a following publication.

The generic model of the rules is substantially a Bayesian representation of the statistics of the environment, which means it is geared to representation of nondeterministic rules relating properties of, and relations between, objects. The description of a specific structure is also nondeterministic in the sense that all properties and relations may take a range of values with an associated probability distribution.

Y02 A System for Extracting 3-Dimensional Measurements From a Stereo Pair of TV Cameras

Y. Yakimovsky and R. Cunningham

Technical Memorandum 33-769, May 15, 1976

Obtaining accurate three-dimensional (3-D) measurement from a stereo pair of TV cameras is a task requiring camera modeling, calibration, and the matching of two images of a real 3-D point on the two TV pictures. A system which models and calibrates the cameras and pairs the two images of a real-world point in the two pictures, either manually or automatically, was implemented at JPL. This system is operating and provides three-dimensional measurement resolution of ±1 mm at distances of about 2 m.

Y03 RAPID—A Random Access Picture Digitizer, Display, and Memory System

Y. Yakimovsky, M. Rayfield, and R. Eskenazi

Technical Memorandum 33-772, May 15, 1976

RAPID is a system capable of providing convenient digital analysis of video data in real-time. RAPID has two modes of operation. The first allows for continuous digitization of an EIA RS-170 video signal. Each frame in the video signal is digitized and written in 1/30-of-a-second into RAPID's internal memory. This memory is organized as a two-dimensional 256 × 256 array of 8-bit bytes. The second mode leaves the content of the internal memory independent of the current input video. In either mode, a digital processor (computer) can randomly access (read or write) any byte (or word) in RAPID's memory specified by a 16 (15) bit address. The cycle time of that access is about 5 μs (5 to 7 CPU cycles). In both modes of operation the image contained in the memory is used to generate an EIA RS-170 composite video output signal representing the digitized image in the memory so that it can be displayed on a monitor.

Y04 DABI—A Data Base for Image Analysis With Nondeterministic Inference Capability

Y. Yakimovsky and R. Cunningham

Technical Memorandum 33-773, May 15, 1976

A description is given of the data base used in the perception subsystem of the Mars robot vehicle prototype being implemented at the Jet Propulsion Laboratory. This data base contains two types of information. The first is generic (uninstantiated, abstract) information that specifies the general rules of perception of objects in the expected environments. The second kind of information is a specific (instantiated) description of a structure, i.e., the properties and relations of objects in the specific case being analyzed. The generic knowledge can be used by the approximate reasoning subsystem to obtain infor-

mation on the specific structures which is not directly measurable by the sensory instruments. Raw measurements are input either from the sensory instruments or a human operator using a CRT or a TTY.

The generic rules of perception are substantially a model representing the statistics of the environment relating the properties of objects, and relations between objects. The description of a specific structure is also nondeterministic in the sense that all properties and relations may take a range of values with an associated probability distribution.

Y05 On the Problem of Embedding Picture Elements in Regions

Y. Yakimovsky and R. Cunningham

Technical Memorandum 33-774, June 1, 1976

New algorithms for region growing in pictures were developed. These algorithms are a step toward finding a satisfactory solution to the image segmentation problem, and in-depth understanding of the problems of nonsemantic image segmentation. The algorithms utilize a sequential decision approach for region boundary detection. The sequential decisions are supported by a stochastic algorithm that maintains local statistics of the region near the boundaries as the region grows. A few illustrations of the algorithm's performance are included.

YANG, F. C.

Y06 Measurements of Electron Density Irregularities in the Ionosphere of Jupiter by Pioneer 10

R. Woo and F. C. Yang

J. Geophys. Res., Space Phys., Vol. 81, No. 19, pp. 3417–3422, July 1, 1976

For abstract, see Woo, R.

YANG, L. C.

Y07 Inherent Time Delay for Dielectric Breakdown in Shock-Loaded x-Cut Quartz

R. A. Graham (Sandia Laboratories) and L. C. Yang

J. Appl. Phys., Vol. 46, No. 12, pp. 5300–5301, December 1975

For abstract, see Graham, R. A.

Y08 Q-Switch Efficiency Increased to 50% by Reducing Pumping Time

L. C. Yang

Laser Focus, Vol. 11, No. 10, pp. 76–77, October 1975

Pockels-cell q switches have been limited in energy efficiency to between 5 and 10% for a q-switched output of several joules. This article describes a method by which efficiency of more than 50% can be obtained by reducing pumping time to near the characteristic decay time of a neodymium-ion excited state.

YEE, J. G.

Y09 The Pioneer 11 1976 Solar Conjunction: A Unique Opportunity to Explore the Heliographic Latitudinal Variations of the Solar Corona

A. L. Berman, J. A. Wackley, S. T. Rockwell, and J. G. Yee

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 136–147, October 15, 1976

For abstract, see Berman, A. L.

YEH, Y. C. M.

Y10 Practical Antireflection Coatings for Metal-Semiconductor Solar Cells

Y. C. M. Yeh, F. P. Ernest, and R. J. Stirn

J. Appl. Phys., Vol. 47, No. 9, pp. 4107–4112, September 1976

The metal-semiconductor solar cell is a potential candidate for converting solar energy to electrical energy for space and terrestrial application. In this paper, a method for obtaining parameters of practical antireflection (AR) coatings for the metal-semiconductor solar cells is given. This method utilizes the measured equivalent index of refraction obtained from ellipsometry, since the surface to be AR coated has a multilayer structure. Both the experimental results and theoretical calculations of optical parameters for Ta_2O_5 AR coatings on Au-GaAs and Au-$GaAs_{0.78}P_{0.22}$ solar cells are presented for comparison.

YEN, S. P. S.

Y11 Functional Colloidal Particles for Immunoresearch

S. P. S. Yen, A. Rembaum, R. S. Molday (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

ACS 169th National Meeting on Emulsion Polymerization, Philadelphia, Pensylvania, April 6–11, 1975 (ACS Symposium Series, No. 24), pp. 236–257

New immunochemical reagents consisting of antibodies bound to crosslinked latex spheres (300 to 3400 Å in size) were used as visual markers for detection and localization of cell surface antigens by scanning electron microscopy as well as light microscopy. The latex spheres were synthesized by aqueous emulsion copolymerization of methacrylate derivatives containing hydroxyl and carboxyl functional groups. Proteins and other molecules containing primary amino groups were covalently bonded to the acrylic spheres under a variety of mild conditions by the aqueous carbodiimide, cyanogen bromide, and glutaraldehyde methods. These latex particles bound to hormones, toxins, lectins, and other molecules have application in localization of cell surface receptors. Latex spheres tagged with dye or radioactive molecules serve as sensitive markers for fluorescent microscopy and as reagents for quantitative studies of cell surface components.

Y12 New Immunolatex Spheres: Visual Markers of Antigens on Lymphocytes for Scanning Electron Microscopy

R. S. Molday (California Institute of Technology), W. J. Dreyer (California Institute of Technology), A. Rembaum, and S. P. S. Yen

J. Cell Biol., Vol. 64, No. 1, pp. 75–88, January 1975

For abstract, see Molday, R S.

Y13 Functional Polymeric Microspheres Based on 2-Hydroxyethyl Methacrylate for Immunochemical Studies

A. Rembaum, S. P. S. Yen, E. Cheong, S. Wallace, R. S. Molday (California Institute of Technology), I. L. Gordon (California Institute of Technology), and W. J. Dreyer (California Institute of Technology)

Macromolecules, Vol. 9, No. 2, pp. 328–336, March–April 1976

For abstract, see Rembaum, A.

Y14 Latex Spheres as Markers for Studies of Cell Surface Receptors by Scanning Electron Microscopy

R. S. Molday (California Institute of Technology), W. J. Dreyer (California Institute of Technology), A. Rembaum, and S. P. S. Yen

Nature, Vol. 249, No. 5452, pp. 81–83, May 3, 1974

For abstract, see Molday, R. S.

YIP, K. W.

Y15 LS 44—An Improved Deep Space Network Station Location Set for Viking Navigation

H. M. Koble, G. E. Pease, and K. W. Yip

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 79–98, October 15, 1976

For abstract, see Koble, H. M.

YOUNG, J. W.

Y16 Five-Color Photoelectric Photometry of Asteroid 433 Eros

E. D. Miner and J. W. Young

Icarus, Vol. 28, No. 1, pp. 43–51, May 1976

For abstract, see Miner, E D.

YU, T. C.

Y17 LUMIS Interactive Graphics Operating Instructions and System Specifications

N. A. Bryant, T. C. Yu, and A. J. Landini

Special Publication 43-31, August 15, 1976

For abstract, see Bryant, N. A.

ZANTESON, R. A.

Z01 Magnitude of 64-m Elevation Axis Movements Due to Alidade Temperature Changes

N. T. Hung, H. P. Phillips, and R. A. Zanteson

The Deep Space Network: September and October 1976, DSN Progress Report 42-36, pp. 41–44, December 15, 1976

For abstract, see Hung, N. T.

ZEIGLER, F. J.

Z02 A Technique for Generating Correlated X-Band Weather Degradation Statistics

E. C. Posner and F. J. Zeigler

The Deep Space Network: July and August 1976, DSN Progress Report 42-35, pp. 180–196, October 15, 1976

For abstract, see Posner, E. C.

ZISK, S. H.

Z03 Final Report: Apollo Experiment S-217 IR/Radar Study of Apollo Data

T. W. Thompson, H. J. Moore (United States Geological Survey), G. G. Schaber (United States Geological Survey), R. W. Shorthill (University of Utah), E. A. Whitaker (University of Arizona), and S. H. Zisk (NEROC Haystack Observatory)

Technical Memorandum 33-787, October 1, 1976

For abstract, see Thompson, T. W.

ZOHAR, S.

Z04 Rounding and Truncation in Radix (–2) Systems

S. Zohar

IEEE Trans. Computers, Vol. C-25, No. 5, pp. 464–469, May 1976

Examination of rounding and truncation errors in radix (–2) systems establishes the following facts: (1) truncation error is 33 percent lower than in the positive radix case; (2) there is no 1-bit rounding algorithm; (3) the error bound of the standard (1-bit) positive radix rounding algorithm can be approached asymptotically by using more than one of the discarded bits. For N bits, this error bound is multiplied by $1 + (3 \cdot 2^{N-1})^{-1}$. Realizations of the algorithms for $N = 2$ through 5 are presented.

Z05 A Realization of the RAM Digital Filter

S. Zohar

IEEE Trans. Computers, Vol. C-25, No, 10, pp. 1048–1052, October 1976

The digital filtering algorithm of W. D. Little, which employs a large RAM to obtain high speed, is implemented in a simple hardware configuration. The nonrecursive version of this filter is compared to the counting digital filter and found to be competitive for low-order filters up to order 7 (8 coefficients).

ZYGIELBAUM, A. I.

Z06 Venus Station Automation: Communications Link

A. I. Zygielbaum

The Deep Space Network: November and December 1975, DSN Progress Report 42-31, pp. 88–95, February 15, 1976

A highly error-resistant communications system has been developed in support of the demonstration of the remote automatic control of the Venus Station (DSS 13). This article describes in general the computer communications software used to connect the JPL control terminal to the Venus Station, and describes in some detail the software used to drive the teletype line which is part of the link.

Subject Index

Subject Categories

Subjects

Publication Index

Technical Reports and Special Publications

The Deep Space Network: November 1974–October 1975 (DSN Progress Reports 42-25 through 42-30)

The Deep Space Network: November 1974–October 1975 (DSN Progress Reports 42-25 through 42-30) (contd)

JPL Technical Section	Entry
430 DSN Systems Engineering Office (contd)	B66
	B67
	C13
	G03
	G22
	G23
	G24
	G25
	G35
	M55
	M56
	M57
	M81
	M82
	M83
430 DSN Systems Engineering Office (contd)	R22
	R23
	R24
	R25
	U03
	U04
430 TDA Engineering	B25
	B68
	L53
	R06
	R26
	R27
	W24
511 Quality Assurance DSN and Mechanical Hardware	S12

Technical Memorandums

Number	Entry
33-697, Rev. 1	M35
33-734, Vol. I	J15
33-752, Vol. I	G28
33-753	S01
33-754	A02
33-755	K38
33-756	T06
33-757	C22
33-758	R31
33-759	P17
33-760	M45
33-761	Y01
33-763	S68
33-764	A32
33-765	D04
33-766	T39
33-767	M36
33-769	Y02
33-770	L22
33-771	T16
33-772	Y03
33-773	Y04
33-774	Y05
33-775	C14
33-777	J16
33-778	G04
33-779	T24
33-780	S04
33-781	L15
33-782	K14
33-785	G05
33-786	M77

Technical Memorandums (contd)

Open Literature Reporting

Open Literature Reporting (contd)

Open Literature Reporting (contd)

Open Literature Reporting (contd)

Open Literature Reporting (contd)

Open Literature Reporting (contd)

Publication	Entry
Vol. II, pp. 674–675	H18
Proc. Sixth Lunar Sci. Conf. (Suppl. 6, Geochim. Cosmochim. Acta)	
pp. 2677–2688	J22
pp. 2769–2784	M53
pp. 2785–2796	A18
pp. 2999–3012	G19
pp. 3527–3540	H05
Proc. SPIE Conf. Cardiovascular Imaging and Image Processing, Theory and Practice, Stanford, Calif., July 1975	
Vol. 72, pp. 159–162	S14
Proc. SPIE Conf. Fibers & Integrated Opt., Reston, Va., Mar. 22–23 1976	
Vol. 77, pp. 78–86	B27
Vol. 77, pp. 103–108	N11
Proc. SPIE Conf. Image Processing, Pacific Grove, Calif., Feb. 24–26, 1976	
Vol. 74, pp. 234–238	L61
Proc. SPIE Conf. Low Light Level Devices for Sci. and Technol., Reston, Va., Mar. 22–23, 1976	
Vol. 78, pp. 60–64	V09
Proc. SPIE Seminar on Efficient Transmission of Pictorial Information, San Diego, Calif., Aug. 21–22, 1975	
Vol. 66, pp. 122–137	H26
Proc. Tenth Int. Symp. Remote Sensing of Environ., Univ. of Michigan, Ann Arbor, Mich., Oct. 6–10, 1975	
pp. 985–994	K02
Proc. Twenty-Fifth Int. Astronaut. Congress, Amsterdam, Netherlands, Sept. 30–Oct. 5, 1974	
pp. 309–334	R05
Proc. 1975 IEEE Conf. Decision and Control, Houston, Tex., Dec. 10–12, 1975	
pp. 81–91	B23
pp. 337–346	B42
pp. 489–498	T20
Pub. Astron. Soc. Pacific	
Vol. 87, No. 519, pp. 785–787	P32
Remote Sensing Environ.	
Vol. 5, No. 3, pp. 169–175	E07
Rev. Sci. Instrum.	
Vol. 47, No. 6, pp. 720–725	R30
Rubber Chem. Technol.	
Vol. 48, No. 5, pp. 944–952	K04
Vol. 49, No. 4, pp. 1001–1009	K05
SAE Business Aircraft Meeting, Wichita, Kansas, April 6–9, 1976	
Paper 760469	M46
SAE National Aerospace Engineering and Manufacturing Meeting, Culver City, Calif., Nov. 17–20, 1975	
Paper 751066	W06
SAE West Coast Meeting, San Francisco, Calif., Aug. 9–12, 1976	
Paper 760609	F09
Science	
Vol. 191, No. 4225, pp. 379–380	K03
Vol. 191, No. 4232, pp. 1174–1175	W15
Vol. 193, No. 4255, pp. 776–780	F05
Vol. 193, No. 4255, pp. 780–786	K15
Solid-State Electron.	
Vol. 19, No. 3, pp. 235–239	L46
Space Research XV	
pp. 117–121	W16
Space Sci. Rev.	
Vol. 19, No. 1, pp. 3–57	M91
The Moon	
Vol. 14, No. 2, pp. 263–289	C34
Vol. 15, Nos. 1/2, pp. 155–163	T23

Open Literature Reporting (contd)